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ERRATA.

Page
77, line 8 from bottom, for DICTOSPHÆRIA, read DICTYOSPHÆRIA.
252, line 1, for *Gondypodaria*, read *Gonypodaria*.
382, line 31, for *Axinissa*, read *Axinyssa*.

Minor corrections have been incorporated in the Index.

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THE JOURNAL

OF

THE LINNEAN SOCIETY.

(ZOOLOGY.)

Reports on the Marine Biology of the Sudanese Red Sea, from Collections made by Cyril Crossland, M.A., B.Sc., F.Z.S. Communicated, with an Introduction, by W. A. Herdman, D.Sc., F.R.S., President of the Linnean Society.

I.—INTRODUCTION.

By Prof. W. A. Herdman, F.R.S., P.L.S.

In the summer of 1904 I was given the opportunity of selecting a Marine Biologist to investigate, under my general direction, the fauna and flora of the Sudan Coast of the Red Sea and the conditions under which they exist. The arrangement proposed and accepted was that the Naturalist appointed should receive my directions and advice before starting, should furnish me with frequent reports and send home collections as occasion offered, that the Liverpool Laboratory should be the home of the collections and headquarters of the expedition, that I should furnish such information and further directions from time to time as might be possible, and that finally we should publish a joint report upon the results at the conclusion of the investigation.

From several well-qualified young Naturalists who applied, I was fortunate in being able to select Mr. Cyril Crossland, who had already had experience in collecting in tropical seas under Sir Charles Eliot at Zanzibar, and on his own expedition at the Cape Verde Islands. That Mr. Crossland has again

shown himself to be a keen and indefatigable collector and an accomplished Zoologist will be abundantly evident from the pages that follow in this Report; but I am glad to have this opportunity of stating also how agreeable and helpful he has been throughout our intercourse, and how much pleasure it has given me to be associated with him in this joint enterprise.

Mr. Crossland left England in October 1904, and, after some necessary and not unprofitable delays in Egypt, reached the Red Sea and eventually Suakim early in 1905. He remained in that neighbourhood cruising both to the north and south, exploring the reefs and lagoons and investigating the marine fauna and flora in every possible way until May, and then returned home, bringing considerable collections which were partly sorted out and distributed to specialists during the ensuing summer and autumn.

These are the groups that will be reported on first in the sections that follow in the present volume. The rest of the collections are now being arranged in Liverpool under my supervision. There is a considerable amount of work to be done on such groups as the Crustacea, for example, in sorting out the material for the specialists; but I hope soon to have them all in the hands of those authorities who have kindly undertaken to examine and report.

In the winter of 1905 Mr. Crossland returned to the Sudan to an independent post, no longer under my direction. As a result of the conditions of his new appointment our original plan of work has required to be modified, and a comprehensive joint report such as we at first contemplated is no longer possible. With regret I have had to cancel, or at least indefinitely postpone, a title-page, which with other MSS. Mr. Crossland left in my hands, referring to such a general report under our joint authorship. It is just possible that if conditions are favourable we may be able to produce such a work at the conclusion of, or as an appendix to, the present series of reports. In the meantime, in my fellow-worker's absence—and he is much further, in time, from Suez than we are—I have had to do what seems best with the MSS. and the collections left in my care; and, with the kind advice of my colleagues at the Linnean Society, I have considered that to publish the following series as reports upon Mr. Crossland's collections, under my editorship, will best meet the views of all concerned and the interests of science.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—II. NARRATIVE of the EXPEDITION. By CYRIL CROSSLAND, M.A. (Cantab.), B.Sc. (Lond.), F.Z.S.; late Lecturer in the University of St. Andrews. (Communicated by Prof. W. A. HERDMAN, F.R.S,, P.L.S.)

(PLATE 1.)

[Read 2nd May, 1907.]

IN November 1904 I had an opportunity of visiting the Red Sea and of making collections of the marine fauna, which I hope may afford an interesting comparison with the numerous collections from the Indian and Pacific Oceans made in recent years.

Several famous collections have been made in the Red Sea already, notably those by Ehrenberg in 1870 ; but of the less commonly known groups which have no readily preserved hard parts, not many species are recorded from the northern and middle parts of the area.

COLLECTING GROUNDS AND HABITATS.—1. SUEZ.

At Suez I spent several weeks, of which a large proportion was given to collecting, principally from the very extensive mud-flats which lie alongside the causeway connecting Port Tewfik with the mainland.

The most dreary and uninviting uniformity of these flats gives place to considerable variety on closer acquaintance, the muds and sands being of varying consistency and constitution with corresponding variety in the fauna they support. The sand is composed in places largely of foraminifera, some areas are covered with sponges, some with weeds. Stones are rather rare, except on the east side at Port Tewfik, near the point where the Suez Creek joins the Ship Canal, where probably their presence is artificial.

Owing to the peculiar tidal conditions of the Red Sea, this is almost the only opportunity I had of digging for worms in sand and mud left uncovered by the sea. At Suez "springs rise 7 feet," but the tides are irregular, their times and height depending on barometer and wind. At the other end of the sea, in the Bab el Mandeb, a considerable tide occurs, but the middle of the sea, as at Suakim, is practically tideless.

Dock walls, the under sides of buoys, and the bottoms of ships in dry dock all yielded harvests.

Suez Bay is shallow and muddy (whence the magnificent green colour which forms such a contrast with the reddish mountains of Ataka), but trawling produced quantities of fine Alcyonarians, Echinoderms, and Sponges, the latter, as always, being the home of many Polychæta and Crustacea. I much regret that I had few opportunities of using the trawl here. I believe much remains to be reaped.

On the Etuleh and Kal el Kebira shoals abound corals of reef-forming species with the Alcyonarians so characteristic of the tropics. Their luxuriance is perhaps not quite that attained further south, but is amply sufficient to constitute a typical specimen of tropical life. This is at 29° 58′ N. latitude; whereas on the other side of Africa corals are scanty, and most forms of life are those characteristic of the Mediterranean, as far south as the Cape Verde Islands in lat. 15° N.*

Suez is indeed the place for a tropical laboratory; less than a week from London, most species of the tropics can be studied without any of the discomforts of heat. Indeed I can testify that Suez has the best climate to be found in Lower Egypt, Alexandria not excepted.

2. Red Sea, West Coast Harbours.

During my voyage south, which I made in a small vessel, I was able to see many little-known harbours and reefs of the Western Shores. The uniformity of the biological conditions of the Red Sea was the most striking impression received, and subsequent more detailed explorations have done little to modify this.

Of all seas this deserves best the name of The Coral Sea. Its shores are all composed of elevated coral, and are fringed with its luxuriant growth; while Barrier and other reefs and patches fill the sea for miles from either shore. In short, corals luxuriate everywhere (with one partial exception noted below) except in the most stagnant creeks.

For a detailed description of this coast I refer to the paper following. The presence of very numerous inlets into the coral plain is a specially important feature from the collector's point of view. These are, however, all of the same type—an opening in the fringing reef bounded by precipitous banks of coral, which extend as submarine walls along each side of the canal-like creek. The species of coral change as one goes up the creek and several kinds of Alcyonaria become prominent, great sheets of brown *Xenia* being especially characteristic of sheltered and cloudy water.

Only close to the head of the tideless landlocked canals do corals disappear and give place to bare mud or sand, with *Zostera* and *Halimeda* as the usual seaweeds of this habitat.

So if we reckoned all coral-reefs alike, we have conditions of extreme simplicity—land and sea both being coral and the products of its decay. But besides the infinite complexity of each coral-reef considered by itself, it must be remembered that the reef of the open sea is quite another thing to the product of perhaps equally luxuriant growth in sheltered water.

* Crossland, C. "The Œcology and Deposits of the Cape Verde Islands," P. Z. S. 1905, pp. 170–186.

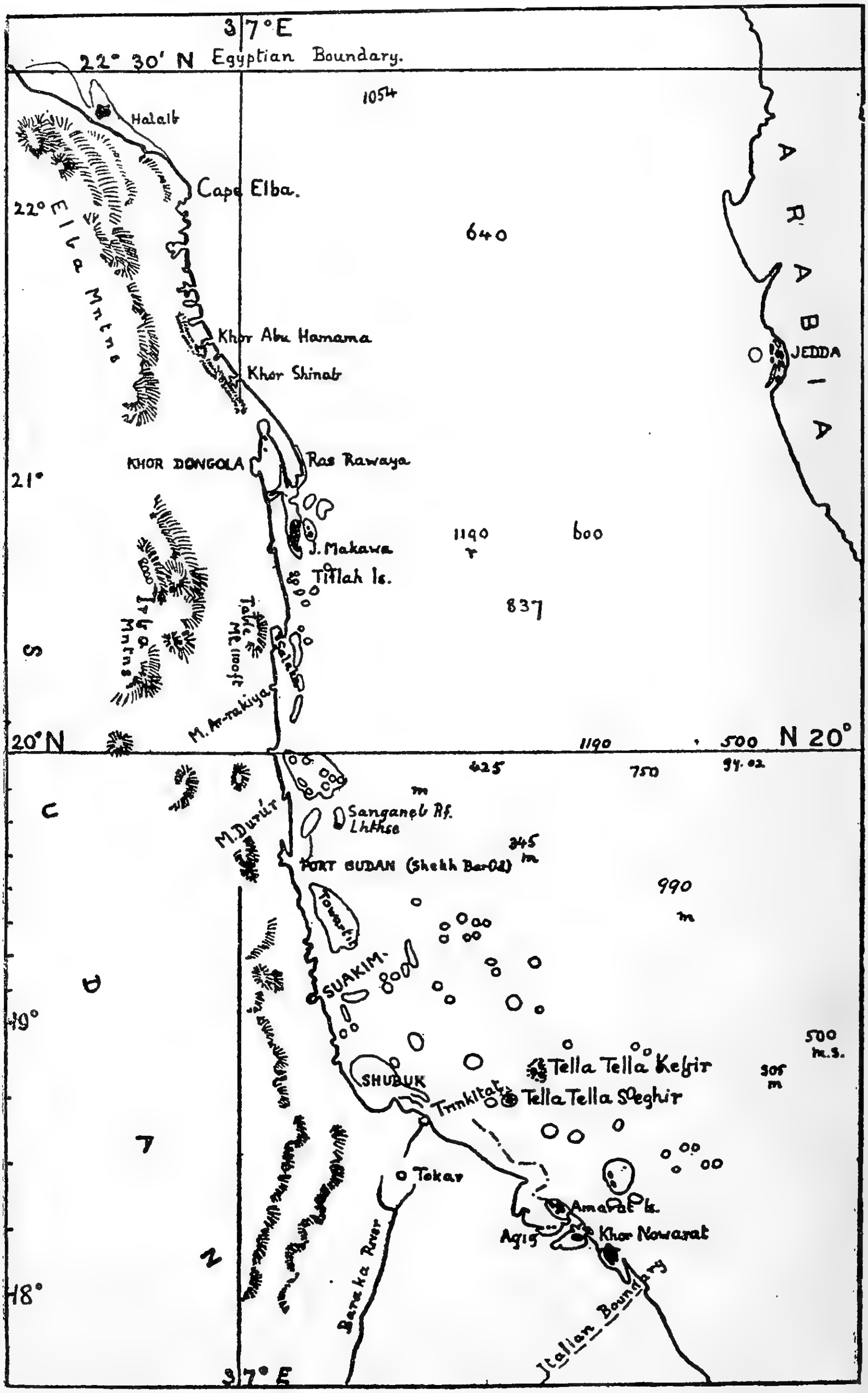
3. Sudan Coast.

Between latitudes 21° 30′ N. and 18° N. I made a particular examination of the coast and found but one exception to the above described uniformity. This is the large enclosed bay of Dongola (or Dongonab as it is more properly called), the peculiar structure of which is probably connected with its biological uniqueness. In the map on p. 15 the thin lines represent reefs and shoals, and it is seen that the area may be described as three deep basins, of which the first is open to the south. The boundary between this and the second is a reef covered by 1 fathom on the west and $2\frac{1}{2}$ fathoms on the east side of the long narrow island which occupies its middle part. The partition between the second and third basins is formed by a large sand-island and the shoals lying round it. Now on the south side of the former barrier all shoals lying below the level at which coral grows with luxuriance are covered with sand and sparsely scattered coral colonies, of which many are dead, just as elsewhere in those places where there is any step between the coral cliff and the floor of coral-mud. North of the barrier on the other hand, the corresponding position is generally occupied by nullipores, either in the form of nodules composed of *Lithothamnion* alone or larger masses of a combination of coral and nullipores, of which the latter is predominant and practically hides the former. There are exceptions, some small nullipore patches being found just south of the barrier and coral occurring in places north of it; but the description holds good that south is a coral area, north is nullipore. But it must be remembered that this applies only to water of 2 or 3 fathoms and over. In the shallows down to 1 fathom corals flourish on both sides of the barrier alike.

In a few places north of the barrier we find surface reefs of rather a peculiar constitution, viz., a combination of coral and nullipore in which the former is necessary as a nucleus for the latter but is almost hidden under it. The coral is not merely dead and overgrown, but still lives on at the ends of some of its branches, a balance being obtained like that between the conflicting interests of parasite and host. The combination has a wonderful rich appearance, being covered again with green and brown moss-like sea-weeds growing with such vigour that striking a "stone" with a hammer causes an effervescence of oxygen bubbles.

If the reason for this change were known in the case of this restricted area, it might throw some light on the unexplained absence of coral, on the reef-forming scale, from the east coast of Zanzibar and British East Africa and other places, where there is no apparent reason for its inability to flourish. Unfortunately there is no solution as yet; I can only state the problem.

Fig. 1.



Map of the Sudan Coast.

The possible causes of the restriction of coral-growth in general are :—

(1) Cold currents.
(2) Very strong currents.
(3) Dirtiness of the water.
(4) Chemical composition of the water including its dilution by fresh water.

(1) and (4) are dismissed at once as inapplicable to either this case or to that of British East Africa. It has been shown too that the effect of an ordinary river upon reefs a comparative short distance from its mouth is generally inappreciable. But there are no permanent rivers in this part of the world.

(2) Strong currents are present in this neighbourhood, but as a matter of fact currents stronger than occur here are generally favourable to coral-growth.

(3) The water in the north basin, where coral grows luxuriantly, forming reefs rising precipitously from deep water, is very dirty, as cloudy as that of Suakim Harbour, for example. That of the middle and southern basins is clear ; even when the strong north wind of winter is blowing, the bottom is clearly visible to a depth of 5 fathoms, and in the summer, when winds of a more normal strength prevail, objects are distinguished clearly at 10–13 fathoms.

Methods of Collecting.

Collecting by dredge and trawl is difficult in a sea where coral is so ubiquitous. Even on the nullipore beds of Dongola " stones " large enough to stop the working of small apparatus abound nearly everywhere. Consequently the majority of my specimens from depths of more than a few feet were obtained by divers or by trawling on coral-mud. Compared with the harvests reaped from other grounds, the results from the latter seem poor. Large quantities of the slender branches of an Antipatharian, certain Polyzoa, several species of Lamellibranchs, &c., were often obtained, but their repeated appearance became monotonous.

Coral colonies brought up by divers, and either broken up at once or left standing in fresh water until the inhabitants came out of their burrows and tubes, yielded many and varied specimens. On one occasion I employed three men for several days in taking coral from a shoal and breaking it up on shore. One result of this was to alter my ideas of the relative abundance of certain forms of life.

One hears little of the use of divers in accounts of collecting expeditions. In most places it is easy to find skilful " swimming divers," and by learning a few words of their language one can easily get them to bring up the particular coral, sponge, alcyonarian, or weed which one has picked out by the water-telescope. In a tideless sea like this their help is invaluable, and indeed in most seas the desirable specimens seem to be just outside the reach of the collector confined to between tide-marks and dredging.

Trawling in the Bay of Agig Suraya was exceptional, resulting in the

finding of a patch of the branching tubes of a species of Lepralid polyzoan. Few Crustacea were found among these, but the number of Polychæta was enormous. The most important is a species of *Chætopterus* whose tubes were enfolded by the polyzoan, and occurred in large numbers. The species is probably that which I named *C. longipes* *, from a single specimen obtained by J. Stanley Gardiner in the Maldives. But the great majority were small forms, and by placing a tub full of the polyzoan in fresh water overnight, I obtained about 4 oz. of representatives of the following families:—

Terebellidæ : 2 species, one of which made up the bulk collected.
Polynoids: in large numbers.
Nereids: 2 species. Numerous.
Eunicidæ: a few dozen.
Syllidæ: 2 or 3 species. Fair numbers.
Sabellidæ: 1 species. Fair numbers.
Serpulidæ and Chætopteridæ. Abundant.

A few each of:—

Lumbriconereids.
Hesionids.
Phyllodocids.

Besides taking every opportunity of examining buoys and their ropes and so on, it is worth while, if one is staying a month in one place, to sink half-a-dozen paraffin boxes, or suspend them in the water, and examine at the end of one's stay. In the present case the boxes remained down for a period of five weeks, and at the end of that time presented a wonderful appearance, being completely covered with brilliantly coloured compound and simple ascidians, some sponges and hydroids and swarms of young lamellibranchs. Among these live hosts of free forms. In this way one obtains an abundance of specimens of species otherwise rare, or not met with at all; in the present case this applied especially to the Planarian worms.

Comparison of Fauna with that of the Equatorial Coast of Africa.

On the whole the two faunas seem much alike, the differences observed being perhaps attributable to the differences of habitat and to the œcological effects following on the unknown factor which encourages the growth of corals here while suppressing them on the Equator.

Alcyonarians †.—In both localities certain forms, especially the Xeniidæ, are in places as abundant as are fucoid weeds on English coasts; but while the lowest tides of Zanzibar uncover sheets of blue and blue-greens, the shallows of the Red Sea harbours are carpeted with brown. The rapid and continual motion of some of these brown and grey Xeniidæ, which

* P. Z. S. 1904, i. p. 277.

† *Cf.* the account of the East African forms by Prof. J. A. Thomson, P. Z. S. 1906, i. pp. 393-443.

fold the tentacles simultaneously over the mouth and straighten them again, is one of the strange things to be seen by the use of a water-telescope. The phenomenon is, I believe, unique among fixed Cœlenterates.

Tubipora is comparatively rare on this coast, though I believe that in other parts of the Red Sea it is as abundant as in the shoals of Zanzibar Channel.

The Planarians * are a group which is only beginning to be known and of which large collections must be slowly accumulated before true comparisons of faunas can be made, but I believe a considerable resemblance between the two regions will be shown by Mr. Laidlaw's papers.

To the Opisthobranchs † the same remark applies, and in addition the migratory habits of many species make it impossible to obtain a fair collection in less than a year's time. The difference in the conditions under which collection was carried on will account for differences in the lists of species quite independently of the real facts of distribution. For instance, the very large and conspicuous *Hexabranchus* was quite common about Zanzibar, whereas here I have seen but one specimen. On the other hand, I believe I collected only one specimen, and that a small one, of *Chromodoris elizabethina* on the equatorial coasts; here I have collected many and have seen, I confess, more than I have captured. I have never yet seen here the great swarms of Aplysiidæ which I met with on the shores of Zanzibar and the Cape Verde Islands.

The Echinodermata are in both localities characterized by the abundance and beauty of the Comatulidæ and the large size of the Holothurians. The latter are not fished as "Trepang" in the Red Sea, the several valuable species known as "Teat fish" being rare or absent.

The brilliant *Pentaceros Lincki* is common here as in East Africa and Ceylon; as are the species of *Linckia*, of which all stages of its peculiar vegetative mode of reproduction are to be met with frequently.

The single littoral Oligochæte is a new species, and has been described under the name *Pontodrilus crosslandi* by Mr. Beddard ‡.

Polychæta.—The ease with which a fair number of species of this group may be collected, together with the diversity of their habits and habitats and the fact that most of them are practically fixed organisms, make the group a specially useful help in studying problems of distribution. Of the few Equatorial species I have so far had opportunity of identifying §, all the

* F. F. Laidlaw, P. Z. S. 1903, pp. 99–113, & 1906, ii. pp. 705–719 (two papers on the East African Collections).

† Sir E. C. Eliot, P. Z. S. 1902, ii. pp. 62–72; 1903, i. pp. 250–257, ii. pp. 354–385; 1904, i. pp. 386–406, ii. pp. 83–103, 268–298, and onwards; also 'Journal of Conchology,' xi. (1905) pp. 237–256, (1906) pp. 298–315, 366–367.

‡ P. Z. S. 1905, ii. [1906] pp. 558–561.

§ C. Crossland, "Fauna of Zanzibar," &c., P. Z. S. 1903, i. p. 169, and onwards to 1904, i. pp. 287–330.

commoner have turned up again in the Red Sea, as have many of those conspicuous forms which are at once recognizable by their colour or tubes.

Plant life resembles that of Equatorial East Africa, in that most of the species are the same, but occur in different proportionate quantities. The absence of coral on the East African reefs is correlated with the vast quantities of the marine phanerogam *Cymodocea ciliata*, Ehrenb., which there occupy the spaces here covered with coral, but even on mud or sand-areas this species is not often met with on the Red Sea coasts. The true seaweeds are the same, but again there is far less ground suited to *Halimeda* spp., which are consequently less frequently met with and then in less abundance.

On shore Mangroves are absent, perhaps because there is no tidal action to plant their floating embryos. Its companion *Jussieua*, with its aerial peg-like roots, is frequently found, but not often in large numbers.

The salt pools found here and there on these arid coasts soon evaporate to a slush of salt crystals, and in these a red microscopic alga flourishes to such an extent as to colour the whole pool. Whether the name "Red Sea" is given from this alga or from the pelagic form which makes a scum as if of iron rust over large areas of the sea occasionally during calms, or from the brown Xeniidæ which carpet the harbour sides, is indeterminable; any one of the three is a striking phenomenon, the first being obvious to shore dwellers, the second to sailors. Perhaps after all, the name was given by landsmen who noted the prevalence of red colour in the hills which border the sea throughout its length.

Reports on the Marine Biology of the Sudanese Red Sea.—III. Note on the Formation of the Shore-cliff near Alexandria. By Cyril Crossland, M.A., B.Sc., F.Z.S. (Communicated by Prof. W. A. Herdman, F.R.S., P.L.S.)

(Plates 2 & 3.)

[Read 2nd May, 1907.]

The *Coast of the Delta* is in the form of an arc of a circle except on its west side, where it runs almost in a straight N.E. and S.W. line from Alexandria to Abukir. These two sections of the coast differ markedly, the former having a very low and sandy shore generally backed by swamps or lakes, the delta being in process of extension, the latter being bounded by low cliffs due to the rapid erosion of the land by the sea. (See Plate 2. figs. 1 & 3.)

The cliffs, with an exception to be noted later, are of the softest material throughout, yet always nearly vertical; a fact the significance of which one would have supposed could not have escaped the notice of the builders of the

numerous villas which have recently occupied the sea-front at Ibrahimieh and elsewhere on this coast.

The cliffs, like the desert of which they represent sections, are formed of wind-blown sand containing in places stones formed by the consolidation of the same material. This is laid down in strata of various thicknesses dipping and curving in all directions. A cutting for the electric railway just beyond Palais Station shows thin laminæ of just consolidated sand; thicker strata, of hard rock, are exposed on the beach.

The material is, in all cases, coarsely ground shell-fragments, the land being thus of marine origin.

The greater bulk of the material above sea-level between Alexandria and the "Sporting Club," a distance of two or three miles, is composed of the rubble, mud and broken pottery remaining from the decay of the ancient suburbs of Alexandria. Plate 2. fig. 2 shows a section of this deposit at its greatest thickness. The ground has been reduced to its ancient level artificially, as shown by the pit in the foreground, which exposes the natural sandstone; and the hill owes its preservation to the strong feeling of the Moslems against the removal of the graves of two Sheikhs which occupy the ground. The head-stones of these graves being 7 feet in height, the hill is about 60 feet. It is composed from top to bottom of rubble, &c., and numerous fragments of red pottery.

At this point the rubble deposit does not reach sea-level, but as the original sand dunes were undulating so the level of the beginning of this formation varies—from sea-level to a height of 60 feet or more above it. But generally in the neighbourhood of Ibrahimieh the greater part of the cliff is composed of these remains. (See Plate 2. fig. 3.) It seems very remarkable how rarely larger stones, such as are invariably used in modern houses, are found among these fragments, but such walls as remain intact embedded in the cliffs are invariably composed of rubble and other materials similar to those used in the walls of the poorer native houses of the present time.

Returning to figs. 1 and 3, a distinct lower layer is seen in the cliffs more or less regularly throughout their length. This is generally a more coherent and homogeneous sand than that above, which contains loose stones. Lower down the beach this passes into sandstone of considerable hardness. As a rule there is a beach of loose sand between the cliffs and the hard rock, which more often, but not always, begins about low-tide level (tides rise 2 feet at springs); but where a continuous bed extends from the cliff to the low-tide level, the interesting point is shown that, simultaneously with the discoloration of the surface under the influence of the sea, a hardening occurs. The light yellow rocks can easily be dug into with the point of a penknife. At the higher level of the blackened area this is possible after the surface layer is removed. Further down the shore the rock can only be scratched by the knife with difficulty though remaining soft inside; the origin of the hard

rock found below high-tide level is apparently a cementation of the sand by deposition of mineral matter from the sea-water, in the same way probably as in the case of the beach sandstone of the Khor Dongola Islands (p. 24 *et seq.*) (Pl. **1.** fig. 3 and its explanation).

Any calcareous matter may be hardened in this way. In places, masses of the rubble of ancient Alexandrine suburbs come to lie below sea-level *, and have been cemented into a breccia containing broken pottery. Such is the origin of the rocks in the foreground of fig. 1 (Pl. **2**), while those in the near distance are of homogeneous sandstone.

Between tide-marks the shore forms a rock-flat, cut up into pools, and with areas of sand bound together by luxuriant patches of phanerogamous weeds. About Ibrahimieh this flat is artificially regular through the operations of the ancient Alexandrians, who filled the ground with graves and catacombs the bottoms of which now remain exposed in the shore-flat, the sea having invaded a large part of the great eastern necropolis. Plate **3.** fig. 1 shows a catacomb passage just above high-tide level. There are side branches to right and left in which the niches for the dead are plainly seen. Further down the shore the graves remain as shallow troughs cut in the rock. The graves spared by the sea are now being carefully despoiled prior to the division of the cemetery into desirable building lots.

Further west the levelling of the shore seems to be the result of quarrying operations rather than of grave-digging.

Along the seaward edge of this rock-flat is a series of masses of harder rock, which, having undergone further hardening under the action of the waves, are being eroded but slowly. Below water-level the edge of the flat is protected by an incrustation very similar to that I described as occupying the same position in the Cape Verde Islands †. The same species of *Vermetus* is here, but

(1) It never forms masses alone.
(2) There is no gradation between the proportions of nullipore and *Vermetus* such as is characteristic of sheltered and exposed situations in the Cape Verdes.
(3) The incrustation consists largely of Serpulid, *Sabellaria*, and Terebellid tubes, which was never the case in the Cape Verdes. The latter two being sandy are a source of weakness.
(4) The incrustation never contains a high proportion of nullipore. Large masses of nullipore are not found ; and the species which covers the

* There seems to have been a sinking of the coast, *cf.* the ruins found out at sea near ancient Canopus, and the now submarine catacombs and excavations of the shore near Ibrahimieh. But of course masses of débris might reach their present position by local subsidence of portions of the cliffs.

† Proc. Zool. Soc. 1905, vol. i. p. 178.

exposed rocks of the Cape Verdes does not occur here. Jointed "Coralline" is very abundant everywhere on the outside of the incrustation.

Specimens of this growth, even those collected within a hundred yards of each other, show differences in the constituents and the proportions in which they occur.

There are two species of *Vermetus*: a smaller with long tube often largely free from the substratum, and a larger with shorter tube forming a coil adpressed to the substratum. The former is the more important here, and is the important organism of the Cape Verdes; the latter occurs usually near high-tide mark and does not often enter into the incrustation, though in some cases it forms the bulk of the mass.

The proportion of sandy tubes of Sabelliformia and Terebellidæ is an important point, as they are a cause of weakness. They do not generally, however, occur in so high a proportion as to destroy the coherence of the whole when maceration removes their binding material.

The proportion of Serpulid tubes, of several species, is always high, often forming fully half the whole mass. Nullipore, as noted above, is low. Hence the comparative weakness of the whole in comparison with the Cape Verde material, which consisted of the two strongest ingredients practically alone. The contrast would be far greater but for the abundance of boring sponge and annelids in the latter locality.

That the shore platform owes, if not its existence, at least its definite edge to this growth is self evident, but a remarkably clear case is afforded by the rocks photographed and shown in Pl. **3**. fig. 2. At a point about a mile east of the Palais station on the Ramleh Railway, *i. e.* about 5 miles east of Alexandria, the rock is both higher and harder than usual on this coast, though formed of the same broken shell material. The headland thus resulting projects into comparatively deep water and is exposed to the full force of the waves. The photograph was taken during the retreat of a wave, and shows very clearly the extremely regular shelf which borders the rocks. The form of the rocks above water-level should be noticed. They show clearly the same weathering which is so characteristic of the "Coral-Rag" of the Tropics, and at this level they have taken on the same extreme hardness.

Reports on the Marine Biology of the Sudanese Red Sea.—IV. The Recent History of the Coral Reefs of the Mid-West Shores of the Red Sea. By Cyril Crossland, M.A., B.Sc., F.Z.S. (Communicated by Prof. W. A. Herdman, F.R.S., P.L.S.)

(Plates **1** & **4**.)

[Read 2nd May, 1907.]

Contents.

General Description of the Coast.

The remarkable parallelism of the sides of the Red Sea "Rift Valley" is varied on the west by three prominent points, Ras Benas, Ras Elba, and Ras Rawaya (see Map, fig. 1, p. 6). Between Ras Rawaya and Suakim the coast-line is, in the main, very regular, but it bends eastward again at Trinkitat, and is broken by some large bays about Agig.

As is well known, the sides of this trough are composed of ranges of mountains of granite and other crystalline rocks remarkable for their wild and jagged shapes and utter barrenness, while the actual coast is a low plain. Except for its seaward border, which is invariably of elevated coral, the surface of this plain is composed of alluvial gravel and sand from the hills *. In certain localities the plain is divided by ranges of low hills, somtimes capped with coral, which rise in the midst of the plain and run parallel, more or less, to both sea-coast and mountains †.

This is the structure of the whole Red Sea coast at least as far south as latitude 18° 10′ N., with the exception of the northern part of the Gulf of Suez, which is totally different ‡.

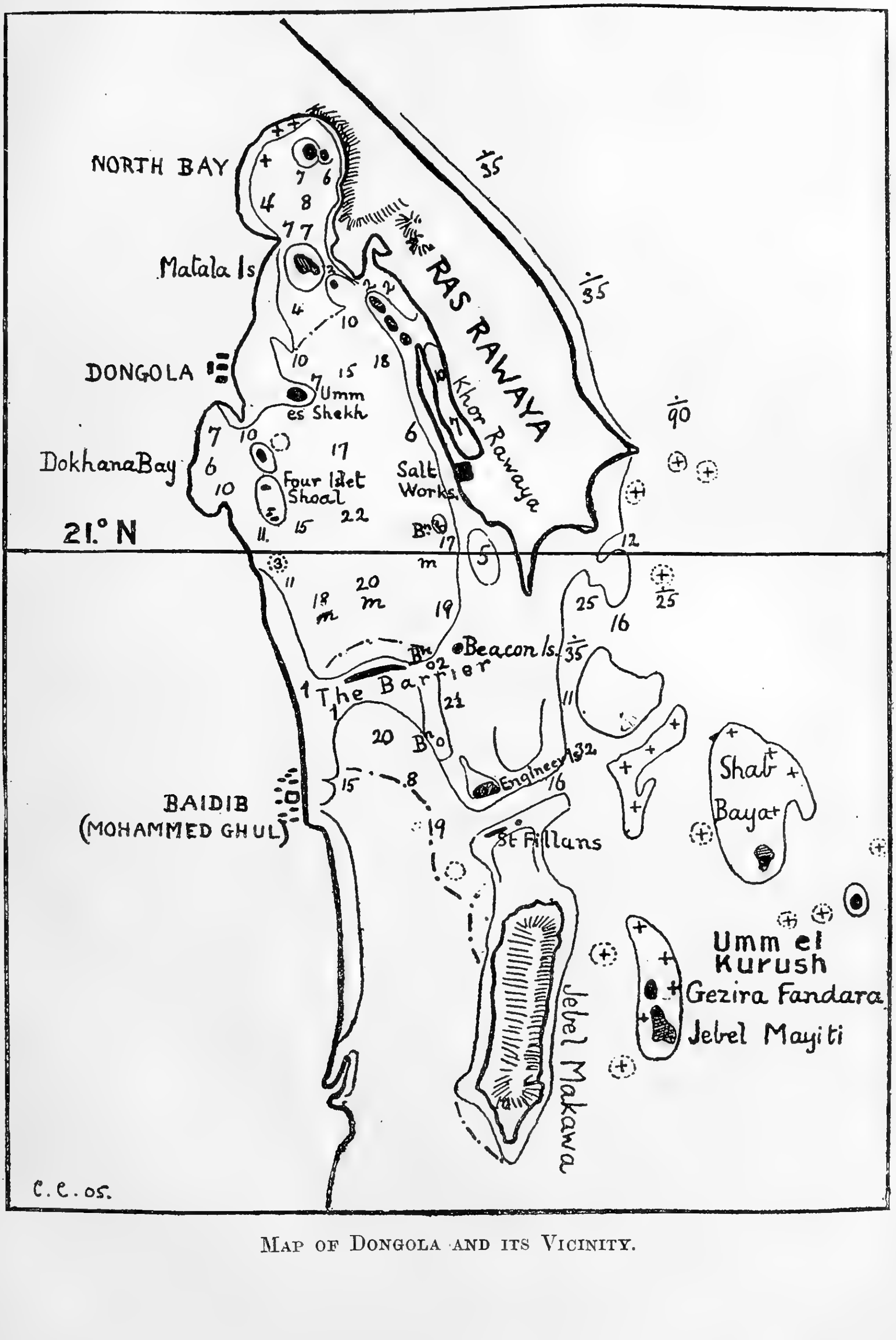
A very striking feature of this coast is the large number of canal-like bays or "Khors" which run into the coast-plain. Reference to the map on p. 6 shows nine large examples in the space of only 40 miles just north of Rawaya,

* Artesian borings made by the Public Works Department of the Sudan Government two miles inland from Port Sudan show that the same materials extend downwards as far as the borings went, *i. e.* to a depth of at least 1000 metres.

† As these hills are of special interest I give an enumeration of them and description of those I have climbed in a postscript (p. 27).

‡ The crystalline hills are here absent, the coast being formed of high, flat-topped, wall-like hills of Cretaceous limestone which rise almost directly from the sea.

Fig. 2.



Map of Dongola and its Vicinity.

and the Chart of Suakim Harbour gives the features of a typical specimen. The characteristics more or less prominently developed in all are:—

(1) Canal-like outline.
(2) Crossed branches running N. & S. and E. & W.
(3) A nearly uniform depth gently shoaling as one passes landwards.
(4) A flat bottom of coral-mud.
(5) Precipitous sides of growing reef below sea-level and cliffs above. The latter are of course the height of the neighbouring plain, generally 2 feet or so in Suakim Harbour, or up to 12 feet in Khor Shinab.

The late Mr. Barron, who was Geologist to the Sudan Government, explains these formations as resulting from two systems of faults at right angles to one another. The almost rainless climate, the absence of very strong tidal currents, and the protection afforded by growing coral, have allowed the above-mentioned characteristic and almost bizarre features to remain, whereas in the corresponding structures on the equatorial coasts of East Africa the erosion of powerful tidal currents and of freshwater streams has, in most cases, widened creeks into bays and broken down their vertical sides into shelving shores.

The Red Sea has an evil reputation with navigators on account of the number and complexity of its coral-reefs and the presence, in certain areas, of that especial horror, the coral pinnacle which rises out of deep blue water to just under the surface. The reefs may be divided into:—

(*a*) Fringing reefs along the coast and round islands.
(*b*) A Barrier system, which is especially typically developed between 19° N. and 24° N.
(*c*) Scattered reefs, including some of Atoll form.

The climate is noted for an extreme aridity, which is however not so complete in the southern part of the coast as in the northern. Among the hills furious rain-storms are frequent in August and winter, which flood the valleys for a few hours at a time in the way described by travellers in the Sinai Peninsula, and by Egyptian Survey Department officials for the desert bordering the Gulf of Suez *. These conditions are of course the best possible for the conveyance of the large quantities of detritus which have formed the great alluvial maritime plain.

The tides have been referred to in the Narrative (p. 3), where it is stated that the middle part of the Red Sea is practically tideless. There are, however, variations of level of two feet or thereabouts which occur almost daily, but their occurrence is subject to no fixed rule. The rise or fall may be fairly regular for several days, high water being at nearly the same time each day, then it may remain continuously low or continuously high for a short period. Occasionally the water may sink to a foot below its lowest normal

* Barron & Hume: "Topography and Geology of the Eastern Desert of Egypt, Central portion," issued by the Survey Department, Public Works Ministry, p. 282.

level and remain down for one or more days. Further, the mean level is about three feet lower in summer than in winter.

It is found that there is a true tide of a few inches, but that this is swamped by the greater changes of level induced by changes of barometric pressure. The "tides" are therefore quite irregular and cannot be predicted.

My own observations have been made daily for about six months at Dongola, where, owing to its position near the head of a very long bay, the effect of the strength and direction of the winds is very marked, but even there the wind is not the only factor in producing changes of level.

The difference in the level of the whole of the Red Sea in the winter and summer is a result of the monsoons in the Indian Ocean. The total difference between highest water in winter and lowest in summer is about six feet.

Causes of the Forms of the Present Reef System.

The theory advanced is that—(i.) As the region is one where considerable upward movement (at least 500 feet) has occurred since modern reefs began in the Sea, and where elevation is still in progress, Darwin's subsidence theory cannot be called into account for the existence of the barrier reefs at a distance from land and separated from it by deep water, or of the atoll forms of certain reefs. (ii.) The relations between elevated and still living reefs show that the foundations of both are ranges of sandstone hills partly below sea-level. (iii.) The forms of the reefs are due to the balance of aggrading over degrading agents, the former being the growth of coral, nullipores, &c., and the latter the corrosive action of the sea and the rotting caused by boring organisms, &c.

A note on the probable cause of the changes effected after the upheaval of a coral-reef, whereby it takes on the hardness, homogeneity, and crystalline structure characteristic of "Coral-Rag," is appended.

Evidences of Elevation.

The existence of the coast-plain and its breadth, which on the Sudan coast averages five miles, are against any considerable movement of depression during its formation. The raised reefs indicate upward movements of 1500 feet or more, and more recent changes are recorded as raised beaches and old erosion-lines or cliffs, of which examples are found throughout the length of the Sudan coast.

At Agig, a mile inland, but only a few feet above the sea, is a raised beach in the form of a long ridge of rolled pebbles of crystalline rock corresponding to that of coral-fragments which borders the present shore. Both are surmounted by a line of graves, the seashore having been, apparently, a favourite place of sepulture through all ages. Even the design of the graves

remains much the same, except that the modern stones are but a fraction of the size of the monoliths of the old days.

Some particularly conspicuous cases of raised erosion-lines on cliffs are to be seen at Tella Tella Suraya Island in the south, and on Haysoit Island in Khor Dongonab in the north. These are treble lines, the modern one at sea-level, and two others at points 3 and 5 feet above this. A single raised line may be seen in the harbours of Port Sudan and Suakim. The larger of the islets of the landlocked North Bay of Khor Dongonab is of limestone, and has a line of undermined cliffs along its northern, or exposed, side, the base of which is now some feet above sea-level and separated from the shore by a stretch of sand about a hundred yards wide, and covered with the xerophytic plants usually found on these dry sandy islets. One should note that the higher cliffs, seen from a distance, appear to show lines of undermining in some cases, but that these, on a nearer view, turn out to be the results of subaerial denudation. The hills are formed of horizontal strata which are in some cases alternately hard and soft, and the latter, standing out from the general level, simulate the overhanging part of a marine cliff. But in these selected cases, as in that described below, the smaller details of wave-action are preserved so that the former, lower, position of the cliff is evident beyond doubt.

The horizontal position of the strata shows that the elevation of the limestone from the sea has been effected in a regular manner ; but evidence of the steadiness of this movement is given by the occurrence everywhere of elevated coral colonies, which are in the same position exactly, relatively to the surrounding rock, as that in which they once grew in the sea. Such colonies may be of quite delicate branched species, and good examples of such are exposed in the trench which surrounds one of the blockhouses which once protected Suakim from the Dervishes, but generally the fact is more easily made out in the case of massive species. Very conspicuous examples were seen on Tella Tella Suraya, an island of which the Admiralty ‘Pilot Book’ notes that it is distinguished by the presence of many cairns of stones upon its highest parts. The island is about 40 feet high and surrounded by cliffs, mostly of rather loose coral-fragments and abundant shells &c. of present-day species. The “cairns” on the level summit of these cliffs are simply large hemispherical coral colonies which survive the weathering that has removed the surrounding softer material. Corals similarly situated are exposed in many places on these coasts, the summit of Jebel Têtâwib in Khor Dongonab bearing a particularly fine series. There would be no difficulty in identifying them as species at present living in the adjacent sea. The island is a miniature elevated atoll, the present bottom of the lagoon being just above the sea-level, and consisting of a flat sheet of mud, which was drying and slightly crusted with salt at the time of our visit, at the beginning of March. This depression is surrounded by high ground, its present communication with the sea being probably subterranean. The lagoon is bordered by bushes, of the species which live in

salt swamps, and about six feet above them are small cliffs which show very distinct marks of having been undermined by waves at a time when the lagoon was at a lower level and contained water. Above these the ground slopes steeply to the level of the summit of the cliffs.

For other elevations see the postscript on the sandstone coast-hills (p. 27).

Two sets of elevations have been shown to have occurred since reefs of modern corals began to be formed in the Red Sea: (i.) A major series up to at least 500 feet (Rawaya, Makawa, &c.). (ii.) Minor elevations which are very recent and are probably still going on. (Recent raised beaches and erosion-lines on the cliffs.)

The Living Reefs.

Fringing Reefs.

These reefs occur practically everywhere on the open coast and in the bays and "khors" except at their extreme landward ends. Their absence from parts of Khor Dongonab has been noted in the Narrative (p. 5). They are absent also from small lengths of the coast-line at Ras Baridi (noted by Darwin, on the east side of the sea) and from the shores of "Dokhana Bay" in Khor Dongonab. As in one or two similar cases in British East Africa, I can give no reasons for these omissions except in one case—the harbour of Dabadib, on the Sudan coast between Salak and Port Sudan. Here the coral-border to the coast-plain is almost entirely covered by a deposit of the very fine sand, derived from crystalline rocks, which at times of high winds causes thick "fogs" in the Red Sea. This fouls the water and prevents coral-growth in the immediate vicinity. Probably the case of "Dokhana Bay" is the same; the water certainly is muddy there, but I have not determined the origin of the mud, and in some cases, *e. g.* Suakim Harbour and especially the North Bay of Khor Dongonab, coral can flourish in very cloudy water *.

The shore-reef is broad where the coast is low: *e. g.*, at the entrance to Suakim Harbour, where it is but a foot or two above sea-level, the reef is $1\frac{1}{2}$ sea-miles broad, while at Port Sudan (Mersa Shêkh Barûd) the coast is 6 feet high and the reef only $\frac{3}{4}$ mile wide. This difference is obviously due to the lesser rate of erosion where fallen rock protects the base of the cliffs for a time against the sea. It is obvious that the formation of reef-flats by erosion is going on here just as on the Zanzibar coast, but that here it is impossible to determine what proportion of the total breadth attained is due to the cutting-down of the land and what to the addition due to recent coral-growth.

At a point just north of Mersa Abu Hamâma, at Dabadib, Mersa Fîjab, and some other points, the coral-limestone has been nearly completely removed, the shore being formed of the rolled grey pebbles of the alluvial

* Note added Sept. 1907.—Fresh water, flowing underground, enters the sea at Dabadib and "Dokhana Bay" nearly all the year round.

plain. That the greater part of the reef-surface was formed by the removal of elevated coral is conspicuously demonstrated, in the first case mentioned, by the presence of numerous isolated pillars and grotesque rocks of this material scattered over its landward portion, in the third by the presence of coral-rock islands; but at Dabadib, as already mentioned, only a narrow band of rock surface is visible at water-level.

Only narrow reefs are found below the comparatively high cliffs (30–40 feet) of the east side of the North Bay of Khor Dongonab. I attribute this to the reefs being sheltered from the prevailing winds, and consider it merely as a further indication of the importance of erosion as a factor in reef-formation on coral coasts.

The surface of the shore-reefs is generally sandy, but bare rock-patches occur, especially as a border to the growing edge. Stones are rare or quite absent except at the slightly raised seaward margin, where the remains of dead coral colonies are sometimes scattered. Such large and solid stones as those so plentifully scattered on the reef-edge in Zanzibar are, from the nature of the case, altogether absent from this area, which has been formed directly by growth of coral and nullipore *.

The raised edge consists of a gravel of broken coral well covered with nullipore. Outside this is a gentle slope of corals, generally stunted and accompanied by nullipore and alcyonarians (Xeniidæ), which extends to a depth of a fathom or so, after which is a precipitous slope of luxuriant corals reaching as far as we can see with the water-telescope, say to 10 fathoms or beyond.

There is generally a more or less regular boat-channel or series of pools of water a fathom or so deep, with numerous outlets to the open sea, some of which provide anchorages for sambûks (or "dhows" as they are called in Zanzibar).

In shallower water than that found generally off the shore-reefs the maximum depth at which coral grows luxuriantly decreases, for instance on the Shubuk boundary-reef, to be described later. A slope of mud with scattered corals is visible below the precipice of luxuriant growths. Similarly inside the harbours, where also the species of corals change, the delicately branched and fan-like forms, which are in the majority outside, give place to massive *Porites*, *Meandrina*, and so on. On this coast it is the massive genera which are characteristic of sheltered waters, not *vice versâ*.

The fringing-reef on the east side of Jebel Mayiti is also worthy of note. The island is a pyramidal hill, the east side being precipitous. From the summit one looks down upon a brown fringing-reef covered by a foot or two

* The stones found on the raised reef-edge of the Zanzibar coasts are the harder portions of the rock removed during the formation of the reef, which have been preserved in the way described in the paper (*loc. cit.*). The "negro-heads" of Pacific atolls probably have a similar origin.

of water, perhaps one hundred yards wide, and apparently of uniform structure throughout. Its clear-cut edge meets the blue-black deep sea directly, without the intervention of a patch of lighter colour anywhere, giving the most forcible impression of the edge of a fathomless abyss.

Scattered Reefs and the Shubuk Area.

It will be convenient in considering the remaining reefs to divide the coast into two sections—the first from Ras Benas to Suakim, the second from Suakim to the boundary with the Italian territory, Ras Kasar. The former is characterized by the presence of well-developed barrier systems and deep water close to all reefs; the latter by innumerable small scattered reefs and sand and coral islands (the Suakim archipelago) in comparatively shallow water and a shelving bottom, and, in the south, a comparatively slight development of recent coral-growth. The contrast is thus a very strongly marked one and very significant also *. One of these scattered islands, Tella Tella Suraya, has already been described.

The only other feature of interest in this neighbourhood is the Shubuk area, a hundred square miles of the most intricate passages among reefs, surrounded on the N.E. and E. sides by an unbroken reef similar to the ordinary fringing-reef of the shore, and on the S. and W. by the mainland. Most of the reefs enclosed are merely sandbanks capped with a fathom or so of growing coral, but on the more exposed N. and W. sides the coral goes deeper and, where not growing coral, the bottom is largely composed of dead fragments of coral, shells, &c.

The land hereabouts is so low and so cut into by great shallow lagoons, that it is difficult to define a coast-line at all. It is easy to see how this very remarkable area has been formed, the shore-reef spreading seawards rapidly in the shallow water, where its débris would be at once available as a substratum on which the growing zone of coral could advance seawards. Within the growing edge the accumulated mass of corals &c. would undergo decay and solution into the maze of reefs now found there; while others were being carved out of the low coast, and these, when their surfaces were covered with coral, living and dead, would become indistinguishable from those which had grown up *in situ*.

The Barrier System.

But little is to be added to the account given by Darwin in his 'Coral Reefs,' and for a description I refer to his work p. 102 & pp. 143–146 (the latter reference including a special section on the reefs between Suakim and Halaib), and to the map on p. 6 (*supra*). But the facts I have given above show that it is impossible to suppose a secondary subsidence of the

* Note added Sept. 1907.—On land the contrast consists in the absence of sandstone coast-hills, the significance of which will be seen after reading the following pages and the postscript.

middle part of the Red Sea in order to explain the occurrence of barrier-reefs on this coast. The absence of the regular barriers in the southern section is not a consequence of elevation; for the evidence is distinct that the recent movements have been the same here as in the north, but is rather correlated with the different slope of the sea-bottom, and probably, as will be explained later, with the structure of the sides of this part of the rift-valley.

That the latest movement has been one of elevation is shown by the character of the erosion-marks left on the cliffs, which include details which would be comparatively soon weathered away from so soft a rock, especially when one considers the important part played by sand-erosion on this desert coast. The very recent character of the fossils contained in the cliffs is evidence in the same direction.

The present form of most of these reefs is the result of the same processes as have formed those of Zanzibar and East Africa *, where the forces of erosion, with the aid of organic growth insufficient to add to the bulk of the material, have carved out all the characteristic forms of coral reefs. In the Red Sea, coral-growth is still adding greatly to the bulk of the reefs, but that the foundations of the present reefs are due to erosion the examination of the physical geography of this coast proves conclusively.

Ehrenberg, over seventy years ago, stated that the foundation of the Red Sea reefs originated in this way, but here the problem is more complicated than on the Equatorial coasts by the impossibility of distinguishing between that area of a reef which is due to the erosion of elevated coral-rock and that which has been added by recent growth, except in the case of some of the Khor Dongola (Dongonab) reefs, where such additions have not completely concealed the original foundations.

At first sight it seems most probable that these last-mentioned reefs are examples of the mode of formation suggested by Darwin† in the cases of the Farsan and Dahlak archipelagoes, viz. by the collection of sediment on an uneven bottom from which coral-growth took its rise. The Dongola Barrier (map, fig. 2, p. 15), indeed, seems an obvious case of this occurrence, the bank continuing awash for a long distance to the west of the sand islands, and the bottom in the neighbourhood being sandy with no very considerable masses of coral or nullipore growth. But a closer examination shows that this explanation, seemingly so plausible, is not correct, and that, in fact, the bank has a rock foundation merely overlaid by the sandbank and such coral-

* C. Crossland, "The Coral Reefs of Zanzibar," Proc. Camb. Phil. Soc. xi. p. 493; and "The Reefs of Pemba and the East African mainland," *l. c.* xii. 1902, p. 35.

† I confine my quotation to Darwin, as he is the only author who has described the reefs of this part of the Red Sea in general terms. The wider problem has been attacked by numerous workers.

For an epitome of recent views see J. Stanley Gardiner's paper "The Formation of Coral Reefs," in 'Nature,' Feb. 18th, 1904.

growths as occur *. In places, a strip of hard coral-rock showing *sections* of the contained corals and shells is left bare about water-level, below the sand of which the islets are composed, and this is true of most of the other sand islets in Khor Dongola.

I have seen no reefs of any importance, on the Sudan coast at least, which could have had banks of sediment, transported and deposited by currents, for their foundations. On a smaller scale, however, possible examples are those bounding the fine harbour of Mohamed Ghul, several square miles of reefs in the neighbourhood of the village of Dongola, and many of those described in the Shubuk area in the south. Such banks are only to be found in comparatively sheltered situations, never in the open sea around the Barrier system.

Below water-level a careful examination of the bottom shows, in many places, bare rock-flats usually thinly coated with mud. It is thus shown that the Barrier and other reefs of Khor Dongola have been merely carved out of the rock by the action of the sea.

The real Barrier system is even more easily seen to be formed by erosion.

The fact that the reefs between Makawa Island and the peninsula of Rawaya are the remains of a former land-connection between the two is almost obvious, especially as a remnant of this lost land remains as an isolated pillar of coral-limestone, 8 feet high, on "St. Fillan's Reef," nearly midway between the two. Although Makawa Island is high, about 500 feet will not be far from the mark, its southern end is little above sea-level. Similarly, Rawaya, though hills up to 200 feet in height are present, has considerable areas which must in course of time be reduced to reefs, so low are they. The neck joining it to the mainland is particularly low and narrow, so that Rawaya must soon become a chain of limestone islands connected by a complicated reef system indistinguishable from that now connecting it to Makawa Island. Similarly the Barrier system to the south of Makawa, perhaps as far as the Tiflah Islands, is a continuation of the Rawaya-Makawa hills, either as eroded remnants of the range or as submarine hills not yet elevated above sea-level. The latter must be true of the southern reefs, in which case the most likely postulate to account both for their growth and for the existence of other ranges of coral-capped hills *which are parallel to the sides of the rift-valley*, is that the faulting which produced it resulted in the sides being in the form of a series of steps or parallel ridges, upon which the remains of organisms would accumulate far more rapidly than on the intervening troughs or flats, so raising the ridges until corals, finally of reef-building species, could carry the ridge up to the surface comparatively rapidly †.

* From Mr. Stanley Gardiner's last report (in 'Nature') on the Percy Sladen Expedition in H.M.S. 'Sealark' (January 1906) it appears that the fringing-reefs of the Seychelles are another case where recent coral merely coats over older rock.

† J. Stanley Gardiner, "The Building of Atolls," Proc. Camb. Phil. Soc. 1902.

Further north is another prominent point, Ras Benas, which shelters a large bay and has a large island to the south, exactly in the same way as Ras Rawaya. So like, indeed, are the appearances of the two points that the same name, Makawa *, has been given to the islands in both cases.

The Jezira Ridge on Ras Benas corresponds to the high ground on Rawaya, and the Makawa of latitude 23° 50′ N. is obviously the continuation of this range. Similarly the southern continuation of the range is represented by the "Horseshoe Reefs," which still retains a fragment of the ancient island in the form of "a white rock" which "looks like a boat," below which this range ends in another set of reefs.

The third prominent point of this coast is at the mouth of the Straits of Jubal (leading into the Gulf of Suez), where the Zêt Hills run southwards into the sea, where they are broken into a chain of islands ending in that of Shadwan. The process of denudation has here made comparatively little progress. Few reefs exist except those fringing islands—and the islands are high *on all their areas*, *e. g.* Shadwan 990 feet, Jubal 410. But imagine denudation to have progressed to a far greater extent and to have cut down the smaller islands to sea-level, their foundations being at the same time preserved or added to by the growth of coral, and we see that the conversion of a range of hills to a peninsula, island, and chain of barrier-reefs becomes complete, as in the case of Rawaya, Makawa, and Tiflah. The repetition of this arrangement on this coast is striking, but just as some ranges are entirely inland (*e. g.* the Abu Hamâma range), so others are completely transformed to barrier-reefs, or perhaps were never elevated so high as to be continuous with the land, or even to project above the sea. For instance, the long reef, Shab Suadi, seems to be a continuation of the promontory of Salaka, but there are no hills in the vicinity that could be part of its range. The Barrier system *inside* Foul Bay, south of Ras Benas, is not connected with that point or its "Jezira ridge."

To the south this reef system bears the Mirear (lat. 24° 40′) and Siyal (lat. 23°) Islands and some small rocks, the islands being low and flat, only 6 to 12 feet above sea-level, and composed of elevated coral.

The Formation of Coral-Rag.

An instructive comparison can be made between the elevated coral of the Red Sea coast and that of Zanzibar. Both are low, and contain fossilized specimens of the species now living in the adjacent sea, and are consequently among the latest of geological formations. In both cases the alteration of the relative level of land and water has been effected in so regular a manner that the corals of the land retain relatively the position in which they grew when submerged. But in spite of these fundamental resemblances the physical properties of the rocks are as widely different as possible.

* This Arabic name, meaning "that which is resistant," has therefore a deeper significance than its donors supposed.

In one's mental photographs of the two coasts, the most prominent feature in either case is the black colour and fantastic forms of the Zanzibar coast rocks and the light yellow and usually formless characters of those of the Sudan. These are the outward visible signs of equally striking differences in their physical constitutions.

In Zanzibar and British East Africa the low cliffs are of an exceedingly hard crystalline rock, which is so homogeneous and tenacious that the overhanging shelf left by the undermining of the sea may, under favourable circumstances, project for more than four feet without its breaking down. The surface of the rock, both on the coast and inland, is, as already mentioned, almost black, though when broken the rock itself is seen to be white or nearly so. The raised coral of the Red Sea coast, on the other hand, is generally soft, often indeed like loose sandy gravel of shells and coral fragments with the larger coral colonies as embedded stones. The *bases* of the cliffs are somewhat harder ; and though their undermining results in forms which distinctly recall the cliffs of East Africa, the lack of homogeneity and cohesion of their material results either in a monotonous formlessness or, where somewhat harder rock occurs, the substitution of picturesque masses of fallen rock for the bizarre pillars, brackets and arches of the Equatorial coasts.

Although fossils are very abundant in the Zanzibar rock and are visible in section in the cliffs, yet the greater part of the rock near the surface is so homogeneous and shows so little trace of its origin from a loose conglomerate, that there would be great difficulty in separating such fossils as occur from the surrounding matrix.

It is important to notice, however, that in places at a little depth below the surface, the rock becomes much less crystalline and its fossils more easily separable ; in short, it approaches the condition of the Red Sea rock. From quarries made for road metalling, Mr. T. J. Last, Slavery Commissioner in Zanzibar, made large collections of fossils and their casts, and a whole series of stages in the crystallizing process could be easily obtained.

On the Sudan coast again the rock has the characters of that of Zanzibar in certain localities, *but only where the conditions to which it is exposed approximate to those normal on the Equator*; that is, to being " 'twixt wind and water " at the sea-level in places where it is under wave-action *.

The whole surface of Zanzibar is under such conditions owing to its heavy rainfall, but rainfall being practically nil on the Sudan coast we find the hardened crystalline rock only by the sea at water-level. Further, owing to the inappreciable tide, the reefs give constant protection to the cliffs' bases, so that only in exceptional places does one find coral-rock freely exposed to waves and spray. For some reason the reef is absent from the eastern cliffs of the islet of Tella Tella Kebira, which are therefore almost constantly bathed in spray, and have taken on all the characteristics of the Zanzibar rocks, in

* See also the preceding paper on the coast near Alexandria.

marked contrast to the other islets in the vicinity, which have only the usual partial hardening of the undermined portions of their cliffs.

In Khor Dongonab, where protection of the coast by coral is less complete, the foundations of the sand islets is, as already mentioned, of coral-rock, and at sea-level, where it is alternately wetted and dried, it has taken on the typical qualities of "Coral-Rag." In the same way, beach sandstone has in several cases been formed by the cementation of the sand of which the islets are composed, and this is as hard as the coral-rag where it overlies it, becoming softer and softer as it rises above the water-level till, at a height of 3 feet or so, it becomes of a crumbling consistence and passes into the loose sand from which it is derived. (See Pl. **1.** fig. 3 and its explanation.)

The facts cited certainly warrant the conclusion that the alteration of the Zanzibar rock from the mass of more or less loose material, in which condition it was elevated from the sea, to its present crystalline state, and that the rock of quite similar origin in the Red Sea has remained nearly in its primitive condition, is due to the absence of rain and generally of wave-action and spray in the latter region. The details of this action of water have not been worked out, but probably a recrystallization of the calcium carbonate and a partial substitution of magnesium, or dolomitization, occurs, both of these processes tending to harden the remaining product.

Conclusions.

The conclusions to be drawn from the above may be summarized as follows :—

1. That the coast of the Sudan, besides its major elevations amounting to more than 1100 feet, has recently undergone several small elevations, the movements having been uniform in their action and not recently reversed.
2. That the differences between this elevated coral and rock of similar origin elsewhere, *e. g.* on the coast of Equatorial East Africa, is due mainly to the absence of tide and rain in the Red Sea.
3. That the present form of the reefs is due as much to the eroding action of the sea upon this elevated rock as to the growth of corals.

   In the case of *Fringing-Reefs* (including the Shubuk area) the land is cut down to sea-level behind the rim of growing coral. *Barrier-Reefs* are formed: (1) By the direct growth of coral upon submarine hill ranges; the northern ends of these have been elevated, and are now ranges of coral-capped hills, the middle parts remain as peninsulas and islands, the southern as Barrier-reefs. (2) By the cutting down by marine erosion of promontories and islands, and of coral-reefs previously elevated.

POSTSCRIPT.

As the theory of the Barrier Formations here advanced turns on the structure and topography of the coast hills, I give the information I have been able to collect.

The hills are not distinguishable on any map, indeed part of the country is, as yet, unsurveyed, and I have had few opportunities of travelling inland. My account is therefore incomplete, but enough has been done to justify the conclusions drawn.

From seawards these hills are easily distinguished from the jagged hills of igneous origin by their cliffs being of a light yellow colour and by their flat tops; generally also by their position being nearer the sea than the lowest of the igneous hills, and even than the mounds of gravel which occur in places at the foot of the latter.

Passing from South to North, the first range is met with a few miles north of Mersa Durur (see map p. 6) as a chain of low butts rising from the alluvial plain four or five miles inland. These become higher and more continuous as one passes northwards till they end in two considerable hills, of about the same height and area of base, the northern of which is marked on the charts, where it is called Table Mountain and given a height of 1100 feet.

At about five miles inland from Dongonab are one or two small hills standing alone, but further north is a range of higher hills lying inland from the middle of the North Bay and extending towards the Hamâma range, from which it is only separated by an interval of a few miles.

The Abu Hamâma * range (which I so named from its most prominent though not highest peak, a famous landmark for sailors) extends from around the inner branches of Khor Shinab to some distance beyond Khor Abu Hamâma, lying much nearer the sea than do the above. Its height is estimated by the Government Surveyor at from 500 to 700 feet.

These ranges are wholly inland, rising abruptly from the maritime plain, which they divide longitudinally. I have not been able to see whether they are coral-capped, but have seen that their bases, at least, have the structure of the range next described.

The hills of the Rawaya Peninsula and Jebel Makawa form an outer range parallel to the above, and are capped with a stratum of modern corals. They were once barrier reefs, growing upon sandstone foundations.

The highest points of the Rawaya peninsula are near its north end, and eastwards from the salt-works in the south, the northern being an extensive plateau of a height of about 100 feet, the latter a hill of about twice this

* This may be translated "Pigeon Hill," and is so called from the curious shape of its summit.

height. The rest of the surface is low or undulating, generally about twelve feet above sea-level but in many places very little above the sea.

The outline of the peninsula as given on the chart is only approximately correct; it is broken up by many intricate "Khors" or inlets of the sea, of which "Khor Rawaya" is but one.

A section of the Northern plateau is given by a cliff about 60 feet high which borders a fault, now full of sea-water, known as Khor Atôf. The drawing given (Pl. 4) shows its structure, which is typical of the whole of this peninsula. Above is a mass about six feet thick of recent corals (A), all in the position of growth. The large numbers of shells which accompany these are still more easily identified as being of living species.

Next is a thicker stratum apparently of consolidated coral-mud (B & C), containing two characteristic fossils, nullipore nodules and a clypeastrid echinoderm. The latter occurs in large numbers and is easily recognized as a species still living in Khor Atôf.

This is all the reef formation present *. Below it is a bed of gypsum (D) of varying thicknesses up to 12 feet, this resting on a finely laminated and very soft sandstone (E), generally yellow in colour but here often dark green or red.

The coral formations are in horizontal strata, *and are unconformable to the strata on which they rest*, which are considerably folded and contorted.

In the lower parts of the peninsula, the coral stratum is thicker, *e. g.* at Haysoit Island up to 15 feet are exposed, the coral-mud and other strata not appearing above the sea-level. The hill in the south (Jebel Abu Shagara) is similar, forming a great cliff bounding the fault in which lie two inlets of the sea, "Khor Rawaya" opening northwards, and Khor Abu Shagara which runs in from the open sea, *i. e.* from the south. The view eastwards from the summit is striking, the peninsula here consisting of a series of parallel ridges and troughs, the result of smaller faults, some of which contain sea-water inlets. These, like all the Khors above named, run approximately north and south. Jebel Abu Shagara is itself cleft by a great north and south gash in its southern part, which may be taken as one of the coast inlets elevated above the sea for our examination. It shows the same structure as the cliff on the east side, viz., a shallow cap of coral underlaid by gypsum and sandstone as in the north, but here the gypsum band is narrow and may be absent, the sandstone in any case forming the great bulk of the hill. This rock forms also the bulk of the islands of Makawa and Mayiti, which are about 500 and 300 feet high respectively. I have not climbed Makawa, but Mayiti is coral-capped. The east side of all these hills is precipitous, the west sloping.

* I have found no elevated reefs thicker than 15 feet on the Sudan coast. This agrees with the accounts given of those of both shores of the Gulf of Suez and the Sinai Peninsula.

This chain of hills, it is evident, were once islands and submarine banks lying parallel to the coast, their formation and position being a mechanical result of the opening of the rift valley. By marine erosion and the growth of Corals, these became levelled down and built up to a line of barrier reefs, part of which has now been elevated above the sea-level as the coast-ranges and as islands, other parts being elevated to such heights that rapid coral-growth has been possible on their summits. The deeper portions have probably been raised to within the limits of growth of reef corals by the accumulation upon them of the remains of marine organisms, which flourish especially on any elevation of the sea-bottom in the way described by J. Stanley Gardiner*. Thus, by degradation of the parts above sea-level and aggradation below, are formed the level lines of reefs of the barrier system of the present day. This mode of formation is probably the origin of the level band of coral-rock which lies between the alluvial gravel of the maritime plain and the deep sea, and to the presence of which this plain, consisting as it does of large gravel and sand to great depths, is due. (See p. 14, note at bottom of page.)

Sept. 20, 1907. CYRIL CROSSLAND.

EXPLANATION OF THE PLATES.

PLATE 1.

Fig. 1. A pearling canoe and its occupants.

2. Diver returning to the canoe with a captured pearl-oyster.

3. Beach sandstone on the island of Sararat, in Khor Dongonab.

(*a*). Sea horizon.

(*b*). Hard coral-rock, eroded down to sea-level, which forms the foundation of the sand island and of the adjacent living reefs.

(*c*) to (*e*). Band of beach sandstone, smooth and hard at (*c*), rough and moderately hard in the dark band, very soft at (*e*).

(*f*) is the loose sand of which the island was originally composed entirely.

4. Mouth of one of the shallow valleys which drain Rawaya and open into the North Bay. The opening lies between two low cliffs of coral-rock, one of which is shown in the background of the photograph. During the winter, fresh water percolates through the sand of the valley, which it consolidates into beach sandstone where it meets the sea-water. At A the sandstone has a smooth surface, at B broken and apparently undergoing reduction by the sea. This sandstone is found in all the valley mouths in this bay.

Figs. 5 & 6. Part of a large heap of old pearl-shells which forms a considerable part of the island of Umm es Shekh, the Holy Island of Khor Dongonab. Presumably these are the remains of fisheries made in the days when this species was fished only for its pearls, not as now mainly for the mother-of-pearl shell. Needless to say their value, which would be very great if the shells were fresh, is now nil.

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* "The Building of Atolls," Proc. Camb. Phil. Soc. 1902.

Plate 2.

Fig. 1. General view of the cliffs eastwards of Alexandria. The rocks in the foreground are made of rubble consolidated by the sea, the similarly situated reef in the middle distance is natural sandstone.

2. Hill of rubble at Chatby, Alexandria, remaining after the surrounding land has been excavated to its original level.

3. Portion of cliff face situated between 2 and 1 above. The upper part of loose rubble containing pottery, &c.: the lower of very soft sandstone.

Plate 3.

Fig. 1. Catacomb passages exposed by the sea, in the same locality as above. The cliff is coherent sand below, rubble &c. above, as in Pl. 2. fig. 3. Eight niches for bodies can be made out in the foreground, to the left of the main passage.

2. The "Spouting Rock" beyond Palais station, showing the regular shelf surrounding the rock just below water-level and partially laid bare during the retreat of a wave.

Plate 4.

Jebel Têtâwib, in Khor Dongonab, a butt near its southern extremity, seen from its south side. The letter B is at a level about 25 feet above the foreground.

A. Coral colonies, in position of growth, bedded in a mass of loose coral débris, shells, &c.

B. Corals bedded in consolidated coral-mud, forming a harder layer than that formed by either constituent alone and so projecting shelfwise at B. This layer passes gradually into C.

C. Hardened coral-mud. The weathered surface forms rounded masses in low relief.

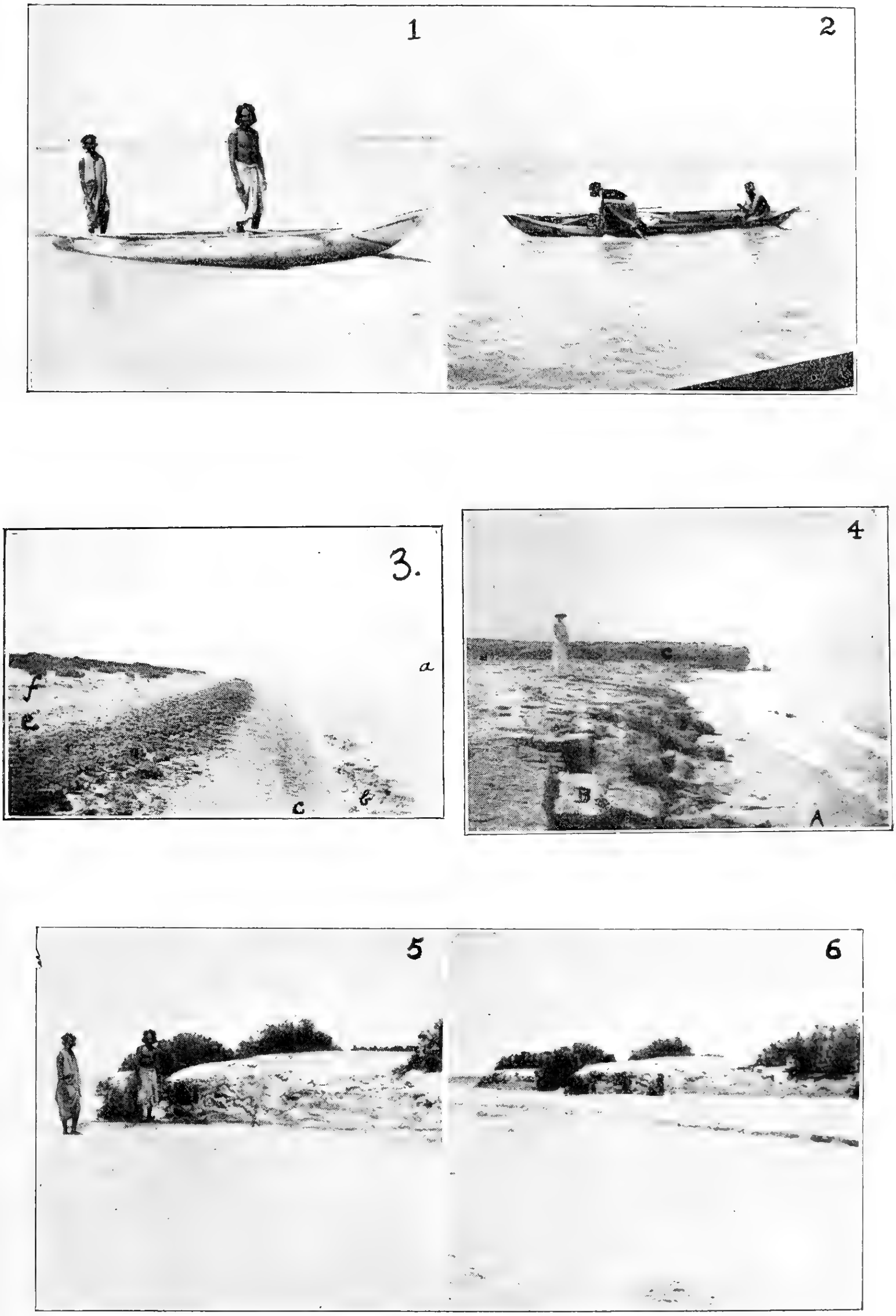
D. Gypsum strata, here steeply tilted, and upturned at their ends in the piece shown in the foreground. They are much folded in other parts of the cliff.

E. Green and red shaly rock underlying and sometimes interstratified with the gypsum. It is here broken down into sand. This rock contains sheets of glass-like recrystallized gypsum.

F. A fallen piece of B. Contrast its roughness with the smooth rounded surfaces of C upon which it lies.

G. Scree material from A & B, consisting of coral and shells.

H. A dark line of reddish broken shell-material, containing many *Cidaris*-spines. This is more prominent in some other parts of the hill.

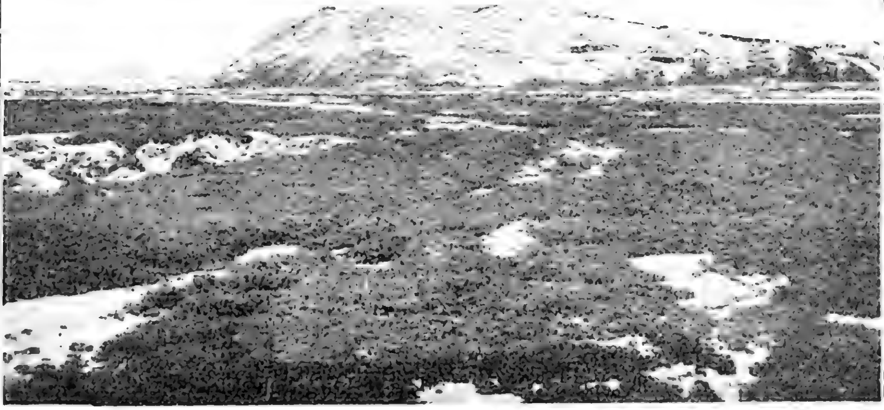


C. C. Photo. Grout, Engr.

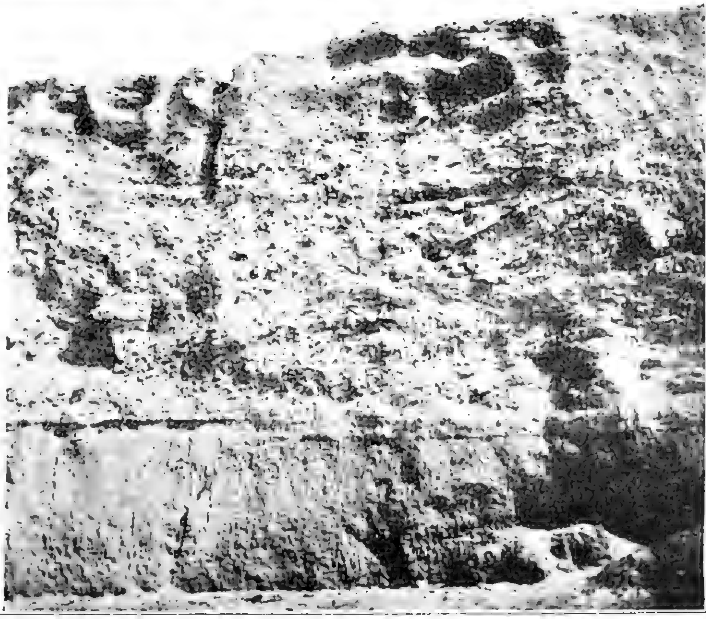
SCENES IN THE RED SEA.

1

2



3



C. C. Photo. Grout, Engr

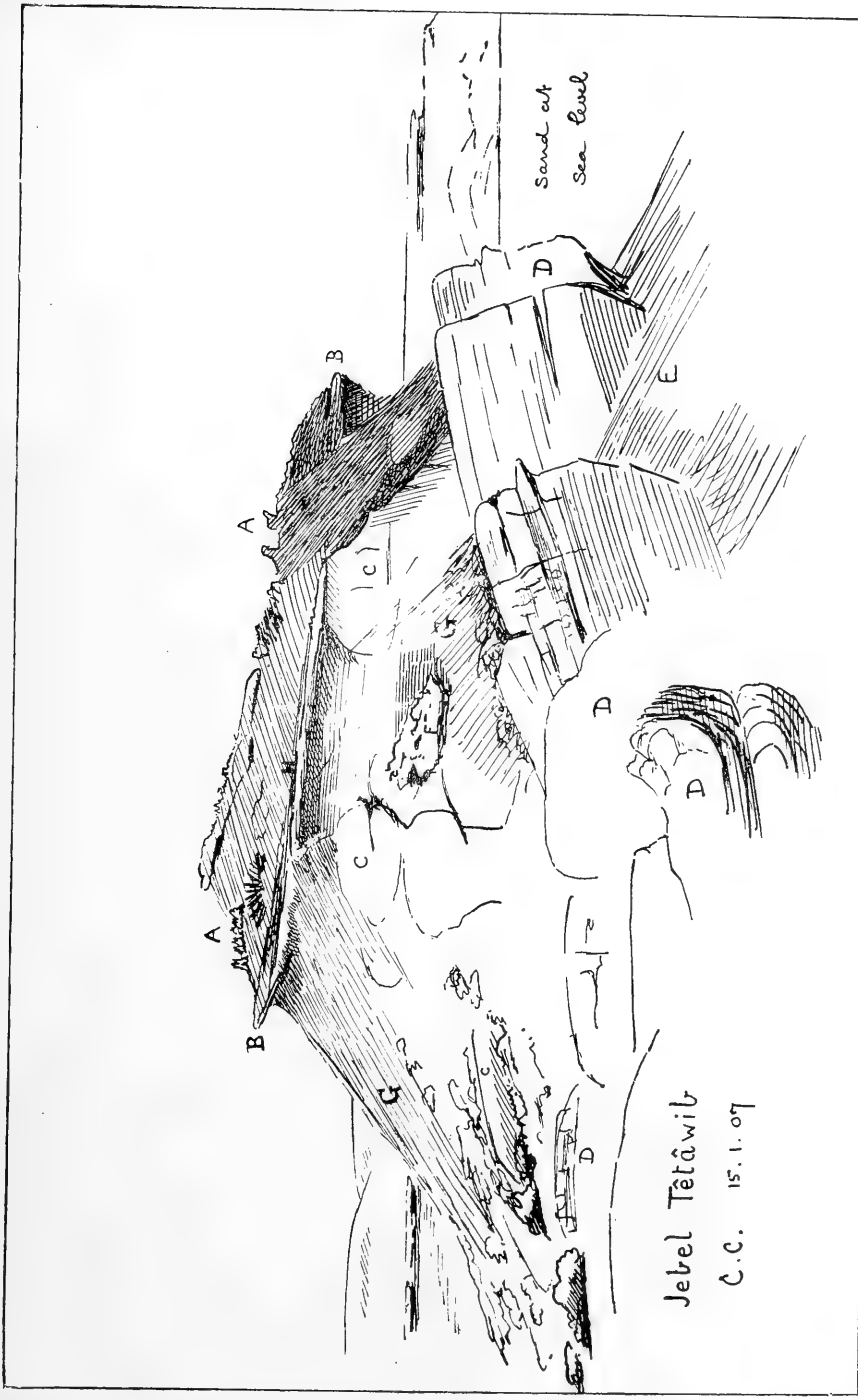
SHORE CLIFFS NEAR ALEXANDRIA.

FIG. 1.

FIG. 2.

C. C. Photo. Grout, Engr.

CLIFFS NEAR ALEXANDRIA.


Sand at
Sea level
Jebel Tetâwib
C.C. 15.1.07

Reports on the Marine Biology of the Sudanese Red Sea.—V. On the Polyplacophora, or Chitons. By E. R. Sykes, F.L.S.

[Read 2nd May, 1907.]

I have taken the opportunity of including in this report a series of specimens collected by Mr. Crossland in East Africa, owing to the similarity of the fauna.

The collection includes ten species: of these seven are identified with known forms, two are described as new, and one is left for the present unnamed.

One feature of special interest in this collection is the identification of the genus *Cryptoplax* from the shores of Eastern Africa; two forms having occurred, both of which appear to be specifically identical with those of Australia and Eastern Seas.

Ischnochiton sp.

Hab. Zanzibar, from a pool in Chuaka Bay, 2–3 fath.

Two specimens of a very small species of *Ischnochiton*, measuring about 5 mill. in length. I am unable to identify them, but, owing to their diminutive size, it seems wiser for the present to leave them unnamed, until either further material or larger specimens be obtained. Colour white, with a brown girdle. Shape resembling the usual form of *Lepidopleurus*. Sculpture punctation on the valves. Valve-slits: end-valves about 14 slits, median 1 slit.

Callistochiton crosslandi, n. sp.

Shell oblong, well elevated, not carinated; pale brownish-white, the girdle similar in colour.

Valves hardly beaked. Lateral areas with two strong riblets, these being granulose, and the interstices nearly smooth; median areas with about twelve fairly strong sub-granulose longitudinal riblets, which often break as they approach the beak, the interstices smooth. Head-valve with thirteen pectinated riblets (apparently formed by the splitting of seven). Tail-valve having the mucro median, the posterior slope a trifle concave, with, by splitting, fifteen riblets. Interior white, a trifle tinged with brown. Head-valve with 8, median valves 1, tail-valves 9 slits: teeth finely pectinated.

Girdle densely covered with well sculptured scales.

Length about 25, breadth about 15 mill.

Hab. Shore at Wasin, East Africa.

A single specimen, which I am unable to reconcile with either of the two species recorded from the Red Sea. As compared with *C. adenensis*, Smith, it is a larger species, with stronger sculpture and fewer ribs on the valves. As compared with the typical form of *C. heterodon*, Pilsbry, it has

two ribs on the lateral areas in place of four, and the tail-valve is concave behind, not convex as described by him and shown in his figures. The var. *savignyi*, founded on a figure of Savigny's, appears to differ in having a smooth central area, with fewer ribs on the head- and tail-valves. I have described the ribs on the head- and tail-valves as seen by me, but I would not place great reliance on the actual number, since they appear to be liable to split up.

CRASPEDOCHITON LAQUEATUS (*Sowerby*).

Chiton laqueatus, Sowerby, Proc. Zool. Soc. 1841, p. 104.
Craspedochiton laqueatus, Sby.; Pilsbry, Man. Conch. vol. xiv. p. 285.

Hab. Zanzibar Channel, 10–20 fath.; also in 5 fath., bottom gravel, broken shells, &c.: Wasin, shore and in 10 fath.

A single specimen from each locality. In my view they are all varying forms of this well-known shell, which, described from the Philippines, has been since identified from Ceylon and the Maldive Is. I have been unable to attach any of these specimens to the recently described *C. tessellatus*, Nierstrasz. It must be borne in mind that the shape of the girdle, &c., varies with the mode of preservation.

ACANTHOCHITES NIERSTRASZI, n. sp.

Shell elongate, moderately elevated, subcarinate. Surface dull, the median area of the central valves white or pinkish, the residue of the valves more or less, irregularly, marked with blackish brown, as are also the anterior and posterior valves.

Median valves somewhat beaked. Dorsal area well-marked, fairly large in size and longitudinally striate. Latero-pleural areas covered with large flat granules, these being rounded towards the beaks and becoming pear-shaped towards the outer margin. The tegmentum of posterior valve is subquadrate, the mucro central.

Interior whitish, sinus moderate in size. Slits as usual in the group. Girdle yellowish-white to brown, large, covered with closely-set hairs; 18 small white tufts of spicules are present, four being in front of the anterior valve, and they arise from greenish pores.

Length about 28, breadth about 18 mill.

Hab. Suez mud-flats; Dock wall at Suez.

Akin to *A. penicillatus*, Desh., but apparently differing from that species in the following characters. The sculpture in the new species is a trifle coarser, the granules not so "regularly" arranged and being rounder near the beaks; the tegmentum of the posterior valve is not rounded, being angular, and the mucro is ventral, not posterior.

I have been unable to trace any "fringe of long peripheral spines" in the present form.

A good series was collected, which vary considerably in their colour pattern : the green pores from which the tufts arise are very conspicuous in spirit specimens.

ACANTHOCHITES PENICILLATUS (*Deshayes*).

Chiton penicillatus, Deshayes, Moll. Réunion, p. 41, pl. vi. figs. 8–10.

Acanthochites penicillatus, Deshayes; Pilsbry, Man. Conch. vol. xv. p. 15, pl. iv. fig. 84, pl. viii. figs. 29, 30.

Hab. Shores of Chaki Chaki Bay, Pemba Island.

A single specimen, identified from a shell, collected by Robillard at Mauritius, and presented to me by Mr. Sowerby. I now feel some doubt whether I was correct in referring * to this form, specimens collected in the Gulf of Manaar. At that time I had not seen the 'Robillard' shell. The figures that I then gave were not good. A single shell of an Acanthochitoid from "Wasin, 10 fath." may belong here, but is too young for accurate specific determination. There is also a very young shell from "shore at Zanzibar" which I think belongs here; it shows the fringe of glassy spicules at the periphery most distinctly.

CRYPTOPLAX BURROWI (*Smith*).

Chiton (Chitonellus) burrowi, Smith, Zool. 'Alert,' p. 85.

Cryptoplax burrowi, Smith; Pilsbry, Man. Conch. vol. xv. p. 54.

Hab. Wasin, East Africa.

A single specimen, which the author of the species has very kindly examined, Hitherto recorded from Australia and the Straits of Macassar.

CRYPTOPLAX STRIATUS (*Lamarck*).

Chitonellus striatus, Lamarck, Anim. sans Vert. vol. vi. p. 317 (1819).

Cryptoplax striatus, Lamarck; Pilsbry, Man. Conch. vol. xv. p. 53.

Hab. Zanzibar, on reef edge, east coast; also 10–20 fath. in Zanzibar Channel, and on the shore. Khor Dongola, washed out of nullipore dredged in 5 fath. just west of Beacon Islet.

After a careful examination of the specimens, as also the separated valves, I am unable to sever the form from this well-known species, which has been recorded from various Australasian localities. In a note some few years ago † I recorded the occurrence of the genus in Natal, and I think the specimen then figured, whose specific standing I was unable to be sure of, really belongs to *C. striatus*. Save for the last mentioned notes, the present paper appears to be the only record of the genus having been found on the shores of Africa. The record from Khor Dongola is referred here with some little doubt as the single specimen is very young.

* Rep. Oyster Fisheries, pt. 1, Suppl. Rep. iv. p. 179.

† J. Malac. vol. vii. p. 164 (1900).

CHITON AFFINIS, *Issel.*

Chiton affinis, Issel, Mal. Mar Rosso, p. 234; Pilsbry, Man. Conch. vol. xiv. p. 181.

Hab. Suez, mud-flats; Suez Bay, among coral.

This form appears to differ from *C. olivaceus*, Spengler [= *C. siculus*, Gray] in the following respects. The girdle scales are in *C. affinis* smaller and bear a few well-marked striæ, while in the other species they have more numerous and fainter striæ, not being smooth as is stated in the text-books. Further, the "smooth triangle on the ridge of each valve," seen in *C. olivaceus*, is replaced in *C. affinis* by an oblong region at the ridge. The riblets again in the last-named shell are more rounded and the valves are, more or less, punctate, between them; also the lateral areas have in the specimens examined only two or three ribs (in Savigny's figure four). I have gone into this detail since the Rev. A. H. Cooke has * stated that the two forms are one species, and this view has been accepted by Mr. E. A. Smith †, the latter adding *C. aereus*, Rve., as another synonym, a view in which I cannot concur ‡. The matter has an importance beyond the mere specific identification, since both authors have utilized the supposed identity as a factor in their discussion as to what, if any, forms are common to the Mediterranean and the Red Sea. In my view the two are distinct, though allied, species.

TONICIA SUEZENSIS (*Reeve*).

Chiton suezensis, Reeve, Conch. Icon. fig. 134.
Tonicia suezensis, Reeve; Pilsbry, Man. Conch. vol. xiv. p. 206.

Hab. Suez, mud-flats, also among coral; Suez Bay, among coral; Suez Bay, among coral, Kal el Kebira shoal; Suez Bay, Etuleh shoal, 2 fath.; Khor Dongola, washed out of dredgings of weed and coral, Engineer Islet, 3 fath.; Khor Dongola, washed out of nullipore dredged in 5 fath., Beacon Islet; Suakim Harbour, coral reefs; Sudan Coast, among coral, Mersa Arrikiya, 1 fath.

ACANTHOPLEURA SPINIGERA, *Sowerby.*

Chiton spiniger, Sowerby, Mag. Nat. Hist., n. s. iv. p. 287, Suppl. pl. xvi. fig. 2.
Acanthopleura spiniger, Sowerby; Pilsbry, Man. Conch. vol. xiv. p. 221.

Hab. Suez mud-flats; Zanzibar, &c.

A long series of this well-known form, which Mr. Crossland notes is "the common high-tide Chiton, everywhere in East Africa, on the cliffs of coral-rag at Djibouti, Mombasa, Zanzibar, Wasin, &c.; also on stones on the edge of reefs of the East Coast of Zanzibar." It has a wide range of distribution, occurring in Australia, the Philippines, &c. (for details see Pilsbry, *l. c.*).

* Ann. Nat. Hist. ser. 6, vol. xviii. p. 394. † Proc. Zool. Soc. 1891, p. 392.

‡ See for a note on this species, Proc. Malac. Soc. vol. ii. p. 195.

Reports on the Marine Biology of the Sudanese Red Sea.—VI. On the Cephalopoda. By William E. Hoyle, M.A., D.Sc. (Communicated by Prof. W. A. Herdman, F.R.S., P.L.S.)

[Read 20th June, 1907.]

The present collection is too small to be the basis of any generalisations regarding the Cephalopod fauna of the Red Sea; so far as it goes, however, it points to a resemblance between the various divisions of the Indian Ocean. Of the nine species which it contains four (possibly five) also occur in the waters around Ceylon and three at Zanzibar. A few specimens collected by Mr. Crossland at the Cape Verde Islands are also included.

The most interesting point, however, is the occurrence in the collection of a complete specimen of *Sepia lefebrei*, which has hitherto only been known from a single shell, described and figured seventy years ago by d'Orbigny.

List of Species.

1. *Polypus vulgaris.*
2. *Polypus* sp.
3. *Polypus granulatus.*
4. *Polypus macropus.*
5. *Polypus horridus.*
6. *Polypus horsti.*
7. *Sepia lefebrei.*
8. *Sepia rouxi.*
9. *Sepia singalensis.*

Polypus vulgaris (*Lamarck*).

Octopus vulgaris, Lamarck, **1799**, p. 18; Férussac & d'Orbigny, **1835**, p. 26, pls. 2, 3 *bis*, pl. 8. figs. 1, 2, pls. 11–15, pl. 29. fig. 6; Jatta, **1896**, p. 212, pl. 4. fig. 1, pl. 7. fig. 9, pl. 8. fig. 6, pl. 22. figs. 2–10, pl. 23. figs. 1–4.

Localities.—Shore near Sal Rei, Boa Vista, Cape Verde Is.; two specimens, ♂ [1436, 1437].

Various localities, St. Vincent, Cape Verde Is.; five specimens, 1 ♂ [1439], 4 ♀ [1440–1443].

Previous records.—Cosmopolitan.

The position of the enlarged suckers on the lateral arms of the males shows some variations, which are worthy of note in regard to the value of this character for diagnostic purposes.

Specimen.	*Arm.*	*Position.*	*Remarks.*
1436	2 R.	8th, 9th.	The enlargement is not very marked; the 9th is followed by a small sucker in the middle line, after which is the usual double series.
	3 R.	11th, 12th.	Enlargement considerable, followed by a sudden diminution, as though the arm had been amputated and grown again.
	2 L.	11th, 12th.	Followed by a gradual diminution.
	3 L.	12th.	Somewhat enlarged, the 11th and everal others have apparently been bitten out and are being reproduced.

Specimen.	*Arm.*	*Position.*	*Remarks.*
1437	2 R. } 3 R. }	9th, 10th.	Followed by a rather sudden diminution.
	2 L.	8th, 9th.	Followed by a very gradual decrease.
	3 L.	10th, 11th.	Do. do.
1439	2 R.	8th to 10th.	Gradual increase, then a small single median sucker, followed by the usual double series.
	3 R.	7th, 8th.	Followed by a sudden diminution.
	2 L.	8th to 10th.	Followed by a gradual diminution.
	3 L.	8th, 9th.	Do. do.

The arms are numbered from the dorsal to the ventral aspect on the right and left sides respectively. It will be seen that the position of the enlarged suckers is not constant in the same specimen, nor even in the two arms of the same pair.

Polypus sp. ?

Locality.—St. Vincent, Cape Verde Is.; six young specimens, ♀ [1444–1449].

These six young Octopuses came in the same bottle with five that I have named *Polypus vulgaris* [1439–1443], and I am not quite sure that they may not be a variety of the same species, but they differ in being much paler and of a reddish rather than a purplish-brown colour above. The dorsal surface of the back, head, neck, and roots of the upper arms is covered with small hemispherical papillæ, not rough, irregular warts. They have two papillæ over each eye, and one example has four arranged in a rhomb on the back. In some respects they resemble *Polypus granulatus*, but the colour is different and the rough surface does not extend over the inner aspect of the umbrella.

On the whole I am inclined to think they are not *P. vulgaris*, but I have failed to identify them with any known form and think it would not be advisable at present to propose a new species for their reception.

Polypus granulatus (*Lamarck*).

Octopus granulatus, Lamarck, **1799**, p. 20.
Polypus granulatus, Hoyle, **1904**, p. 195.

Locality.—Suakim Harbour; one specimen, ♂ [1096].

Previous records.—Cosmopolitan.

Polypus macropus ? (*Risso*).

Octopus macropus, Risso, **1826**, p. 3; Vérany, **1851**, p. 27, pl. 10; Hoyle, **1886**, pp. 11 & 95; Lönnberg, **1897**, p. 706; Joubin, **1898**, p. 22.

Octopus cuvieri, Férussac & d'Orbigny, **1835**, p. 18, pls. 1, 4, 24, & 27; Appellöf, **1886**, p. 6, pl. 1. fig. 6.

Polypus macropus, Hoyle, **1904**, p. 195.

Localities.—Suez Harbour, purchased from fisherman; one specimen, ♀ [1903]; one young specimen, ♀ [1080].

St. Vincent, Cape Verde Is., purchased by the Rev. C. S. Eveleigh; one specimen, ♀ [1438].

Previous records.—Mediterranean; Red Sea; Indo-Malayan Region; Japan; Australia; Teneriffe.

The largest specimen (1093) has a large ovate pinkish body, smooth except for a slight wrinkling, without any warts or cirri. It has the enlarged suckers on the dorsal arms, but the arms are distinctly shorter in proportion to the body than indicated by d'Orbigny's description and figures. The actual measurements are:—

Length of mantle				11 cm.
Length of first arm	Right	53 cm.	Left	51 cm.
Length of second arm	„	53	„	50
Length of third arm	„	38	„	41
Length of fourth arm	„	34	„	35

The smallest specimen (1080) agrees in all essentials with the larger, and is certainly the young of the same species.

Specimen 1438 appears to be referable to this species, but it is in a very unsatisfactory state of preservation and the label states that it was partly decayed when obtained.

POLYPUS HORRIDUS (*d'Orbigny*).

Octopus horridus, d'Orbigny, **1826**, p. 54; Férussac & d'Orbigny, **1835**, p. 51, pl. 7. fig. 3.
Polypus horridus, Hoyle, **1904**, p. 194, pl. 2. figs. 10, 13 [entered by error as *P. aculeatus*]; Id. **1905**, p. 978; Id. **1907**, p. 454.

Localities.—Suez, low tide, December 1904; one specimen, ♂ [1078]; mud flats, January 1905, collected by J. Logan, two young specimens, ♀ [1084, 1085], one ♂ [1083].

Khor Dongola, among coral from reef, three young specimens, ♀ [1086–1088], one sex? [1089]; taken from the crevice of a coral in breaking it up, one young specimen, ♀ [1079].

Suakim Harbour, one specimen, ♀ [1090].

Previous records.—Red Sea, Egyptian shore (*d'Orbigny*); Cape of Good Hope (*Krauss*); Ceylon (*Hoyle*); Male Atoll (*Hoyle*); Zanzibar (*Hoyle*).

Specimen 1078 shows enlarged suckers near the base of the fourth arm on the right side, and of the third and fourth arms on the left; this example is recorded as having been "greenish, with a papillate skin" when fresh.

Specimen 1079 is flaccid and looks as though it had been preserved in formol after death; the pale patches are indistinct; the body is an elongated ovoid, contrasting with the short stumpy form of most other examples.

Specimens 1087 and 1088 are very dark in colour, the paler areolæ being scarcely distinguishable.

Specimen 1089 has the tissues swollen and subgelatinous, as though distended with fluid. It is very dark in colour, almost melanotic, and hence

the characteristic markings are very indistinct; the papillæ in the centres of the lighter areas are small and can only be made out by the aid of a lens. The second and third arms on the left side and the third on the right have been lost and their replacement has commenced. The rudiments of the new arms grow out just below the skin on the outer aspect, as mentioned in the case of *P. horsti*, Hoyle, **1907**, p. 452.

Three specimens (1083–1085), found together, must I think be melanic examples of this species. In strong sunlight I can see indications of the circular lighter-coloured areas, expecially in the larger example, which measures 25 mm. from the posterior end of the mantle to the centre of the eyes. In the smallest, the corresponding measurement of which is 18 mm., they are barely distinguishable; but the three resemble each other so closely that they undoubtedly belong to one species. These specimens were collected half a mile beyond the Bachet Hotel, where a tidal stream flows from the flats into the canal.

Polypus horsti (*Joubin*).

Octopus horsti, Joubin, **1898**, p. 23.
Polypus horsti, Hoyle, **1907**, p. 451.

Localities.—Suakim Harbour, one young specimen, ♀ [1091], one specimen, ♀ [1337]; purchased from a fisherman; one specimen, ♀ [1081].

Previous records.—Jeddah, Red Sea (*Joubin*); Zanzibar (*Hoyle*).

In specimen 1337 the ocellar spots are very indistinct, especially that on the right side, showing that this character might be easily overlooked in certain conditions of the chromatophores. The length of the mantle is 7 mm.; the tip of the hectocotylised arm measures 4 mm. in length, and there are about a dozen delicate transverse ridges in the hollow.

No. 1081 is a very puzzling specimen, and I was at first disposed to identify it as *P. horridus*. The zebra-like markings on the arms are hardly perceptible, but the ocellar spot is very well marked indeed. The surface is very rugose; above and behind each eye is a large wart with three or four wartlets upon it, and a small wart behind it. Above and before each eye is a small wart, whilst another still further forwards in the middle line forms a triangle with these two. There are four warts in the form of a small lozenge on the back and several others scattered irregularly about. The papilla at the posterior end of the mantle is pushed out of the centre and is made out only with difficulty owing to the stretching of the skin in that region. On the whole I regard it as an aberrant example of *P. horsti*.

No. 1091 has a smooth surface and the ocellar spot, but the characteristic transverse barring of the arms is for the most part indistinct; there are, however, traces of it here and there, and as the specimen is young these might very probably become better marked with further development of the individual.

Sepia lefebrei, *d'Orbigny.*

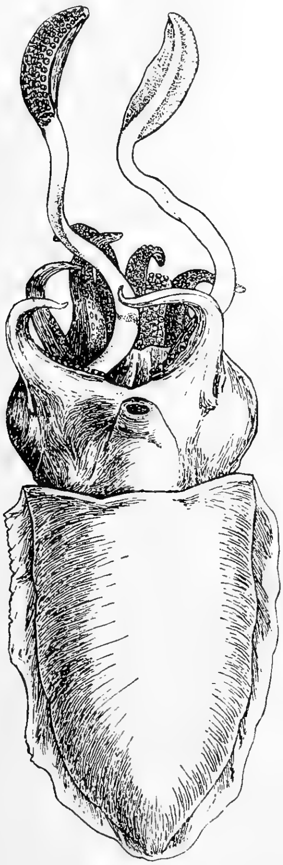
Sepia lefebrei, d'Orbigny, in Férussac & d'Orbigny, **1835**, p. 282, pl. 24. figs. 1-6, 1839; d Orbigny, **1845**, p. 288, pl. 13. figs. 5, 6.

Locality.—Suez mud-flats, 2 to 3 fathoms; one specimen, ♂ [H. 1097].

Previous record.—Koseir, Red Sea.

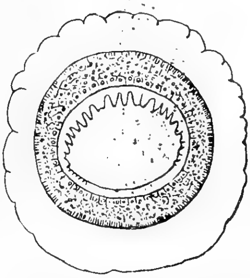
The Body is hemielliptical in outline, narrow, broadest anteriorly, bluntly pointed behind. The *fins* are narrow, only about one-eighth the breadth of

Fig. 1.



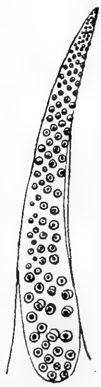
Sepia lefebrei.
Ventral view of the specimen, enlarged about 4/3.

Fig. 2.



A sucker from one of the sessile arms: × 50.

Fig. 3.



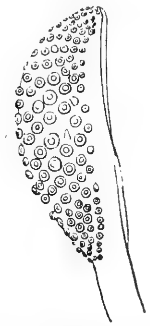
The left ventral hectocotylised arm. × 3.

the body; they extend to the mantle-margin in front and to within about 1 mm. of each other posteriorly. The *mantle-margin* is slightly pointed over the head dorsally, and only very little emarginate below. The *mantle connective* is of the form usual in the genus. The *siphon* is convexly conical and extends just up to the space between the arms.

The Head presents no distinctive characters.

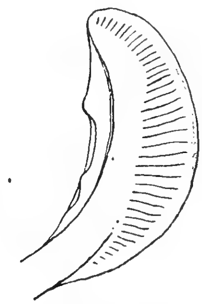
The Arms are subequal, the order of length being 4, 3, 2, 1 on the right side and 4, 2, 3, 1 on the left; they taper evenly towards the extremities; those of the fourth pair are sharply keeled externally. The *suckers* are in four rows, except on the dorsal pair, where they appear to be in two rows owing to the lateral compression of the arms; they are of moderate size and

Fig. 4.



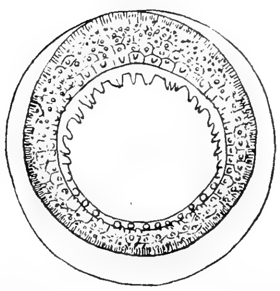
Front view of the tentacular club: × 3.

Fig. 5.



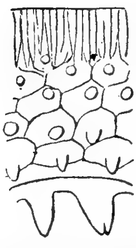
Back view of the tentacular club: × 3.

Fig. 6.



One of the large tentacular suckers: × 50.

Fig. 7.



Portion of the horny ring and papillary area, from the same sucker as fig. 6: × 172.

marked with irregular meridional grooves. The *horny ring* (fig. 2) has about fifteen teeth in the distal semi-circumference, most of these are slender and bluntly pointed, but some are broad, and notched at the extremity as though made up of two or three teeth fused together; there is a papillary area of the usual kind round the horny ring. What I take to be a form of *hectocotylisation* is seen on the fourth left arm (fig. 3); about one-fourth up the arm the two dorsal rows of suckers become much smaller and continue so till rather more than halfway up; no arrangement of grooves and ridges was seen. Perhaps the hectocotylisation was only partially developed; the

genital gland was in a very rudimentary condition, but I believe the specimen to be a male.

The Umbrella is but little developed, especially between the ventral arms. The *buccal membrane* has the usual seven points, five of which bear one sucker each. The *outer lip* is thin with close-set radial grooves; the *inner* thick and papillate.

The Tentacles are about as long as the head and body together; the *stem* is rounded, with three not very prominent angles. The *club* (figs. 4 & 5) is broad, flattened and crescent-shaped; on the dorsal margin is a rather broad marginal web; on the outer surface a series of shallow parallel grooves. The *suckers* are in eight rows, the central ones being the largest and of about the same size as those on the arms; they gradually diminish towards the ends and the sides, the marginal ones being about half the diameter of those in the middle. The *horny rings* of the largest suckers (fig. 6) are somewhat larger than those of the arms; there are sixteen bluntly pointed teeth on the distal semicircumference, many are split as if undergoing bifurcation; the proximal half-ring has about sixteen small, blunt, rounded teeth. The *papillary area* is shown in fig. 7.

The Surface is smooth.

The Colour dull purplish grey, paler and more yellow below.

The Shell in the present example had undergone some maceration and broke in the process of extraction, but it has been admirably depicted by Férussac and d'Orbigny, and the following description is based partly on their figures. It is elongate oval in *outline*, the greatest breadth being nearly in the middle; the free *chitinous margin* is everywhere narrow, broadest in the anterior half, it is continuous and expanded around the hinder end, much as in the genus *Sepiella*, and there is no trace of a *spine*. The *inner cone* is shallow, its limbs slender and extending only about one-fourth the length of the shell. The *dorsal surface* is covered with minute rounded granules. The *ventral surface* is elevated into a large, prominent, rounded keel, which rises gradually from the posterior hollow of the shell, reaches its maximum height a little in front of the middle and sinks more rapidly towards the anterior end; the *last loculus* has an index of 37. It was not possible to make out its hinder boundary exactly, as the shell had become somewhat macerated and was injured in removal.

Dimensions.

End of body to mantle margin	40 mm.
End of body to eye	43
Breadth of body	24
Breadth of head	22
Breadth of fin	3 to 4
Diameter of largest sucker on sessile arm	0·7
Diameter of largest sucker on tentacle	0·7

	Right.	Left.
Length of first arm	15 mm.	15 mm.
Length of second arm	16	16
Length of third arm	17	15
Length of fourth arm	19	18
Length of tentacle........................	55	—

This species has hitherto been known only from the shell, and hence it has been necessary to give a full description of the soft parts.

SEPIA ROUXI, *d'Orbigny.*

Sepia Rouxii, d'Orbigny, in Férussac & d'Orbigny, **1835**, p. 271, pl. 19, 1839.
Sepia rouxi, Hoyle, **1905**, p. 981.

Locality.—Suez, November 1904, purchased from a fisherman; four specimens, ♂ [1074–1077].

Previous records.—Red Sea, Bombay (*d'Orbigny*).

I believe these to be specimens of *Sepia rouxi,* but if this be so the example in Professor Herdman's collection from Ceylon (Hoyle, **1904**, p. 198) has been wrongly determined. The only point in which these examples do not agree with d'Orbigny's figures and description is in the extremely narrow fin. I think that this may be due to contraction, as the specimens had evidently been dead some time and are not well preserved. The teeth in the horny rings of the suckers are not so regular as in d'Orbigny's drawings, but these are frequently rather diagrammatic.

SEPIA SINGALENSIS, *Goodrich.*

Sepia singalensis, Goodrich, **1896**, p. 3, pl. **1**. figs. 4–8; Hoyle, **1905**, p. 198; Hoyle, **1907**, p. 459.

Localities.—Suez, mud-flats, purchased from a fisherman; two specimens [1094, 1095].

Suakim, one specimen [1338].

Previous records.—Ceylon (*Goodrich, Hoyle*); Zanzibar (*Hoyle*).

Egg capsules.

A number of capsules containing well-developed *Sepia* embryos were collected at Mersa Makdah in Shubuk [1082], and other capsules undetermined were found under stones in the mud-flats, Suez Bay [1092].

Treasurer's Account for the Year ending April 30th, 1907.

(Presented at the Anniversary Meeting, May 24th, 1907.)

Receipts and Payments from May 1st, 1906, to April 30th, 1907.

Receipts.				£	s.	d.
Balance at Bankers on 1st May, 1906				361	3	4
Interest on Investments				212	19	9
Admission Fees				180	0	0
Annual Contributions				1548	5	0
Compositions				—	—	—
Sales of Publications:—						
Transactions	£59	3	8			
Journals	69	14	1			
Proceedings and Catalogues	2	2	3			
				131	0	0
Miscellaneous Receipts				105	8	11
Sale of Consols				3855	1	5
" " Westwood Bequest				219	4	8
				£6613	3	1

Payments.				£	s.	d.
Taxes and Insurance				10	18	9
Repairs and Furniture				56	4	2
Coals and Gas				44	3	8
Salaries				798	11	8
Library:—						
Books	£222	9	10			
Binding	91	14	5			
				314	4	3
Expenses of Publications:—						
Printing	£391	18	4			
Illustrations	211	14	8			
Distribution	29	5	0			
				632	18	0
Miscellaneous Printing and Stationery				85	4	10
Petty Expenses (including Tea and Postage)				122	5	0
Re-investment of Cash realised by Sale of Consols				4074	6	1
Investment on April 20th, 1907				30	17	10
Balance at Bankers, 30th April, 1907				443	8	10
				£6613	3	1

Investments on April 30th, 1907.

	£	s.	d.		£	s.	d.
Metropolitan $3\frac{1}{2}$ per cent.	1079	11	3	@ 99	1068	15	3
Great Indian Peninsula Railway, Annuity Class B	42	1	5	@ $21\frac{1}{4}$	894	0	0
Forth Bridge Railway 4 per cent. Stock	450	0	0	@ 114	513	0	0
Metropolitan 3 per cent.	1000	0	0	@ 88	880	0	0
India 3 per cent	500	0	0	@ 89	445	0	0
Eastern Bengal Railway 4 per cent. Debenture Stock	1000	0	0	@ $116\frac{1}{2}$	1165	0	0
Great Western Railway 4 per cent. " "	1000	0	0	@ 119	1190	0	0
Metropolitan Water Board 3 per cent. Stock "B" (Westwood Bequest)	232	5	0	@ 89	206	14	0
					£6362	9	3

HORACE W. MONCKTON, *Treasurer.*

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30th April, 1907, and found them correct.

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THE JOURNAL

OF

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VOL. XXXI. ZOOLOGY. No. 204.

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Reports on the Marine Biology of the Sudanese Red Sea.—VII. The Crinoidea. By Herbert C. Chadwick, A.L.S., Curator of the Port Erin Biological Station. (Communicated by Prof. W. A. Herdman, D.Sc., F.R.S., P.L.S.)

[Read 5th December, 1907.]

The collection of Crinoidea made by Mr. Cyril Crossland on the Sudan coast, and submitted to me for examination, contains six species, only two of which appear to have been previously recorded from the Red Sea. It is worthy of note that the genus *Actinometra* is not represented in the collection. In describing the position of the syzygies in the arms I have adopted, with some hesitation, the view so strongly urged by Bather in his paper entitled "The Term Syzygy in the Description of Crinoids" (Zoologischer Anzeiger, No. 495, 1896), to the effect that the epizygal and hypozygal elements which form what is commonly known as a syzygial pair should be regarded as morphologically equivalent to the ordinary brachial ossicles which are united by muscular bands, and not as forming together one such ossicle. I may perhaps be allowed to point out one objection to Bather's view which appears to me to have some weight. On page 117 of Vol. iii. of Lankester's 'Treatise on Zoology' a syzygy is described as "an immovable sutural union between two brachials of a pinnulate arm, accompanied with loss of the pinnule on the hypozygal." Now, if it be true that in the past history of the Crinoidea the hypozygal was once pinnulate, it is remarkable that the pinnules of the epizygals are invariably on that side of the arm from which the pinnule has been lost. Take, for example, the great majority of the family Antedonidæ. The first pinnule is borne by the second brachial on the outer side of the armlet, and the second pinnule by the epizygal of the first syzygial pair (fourth brachial of Bather) on the inner side of the armlet. But if the hypozygal has lost the pinnule which, it must be assumed, was on the inner side of the arm, that of the epizygal (fourth brachial) is on the wrong side, for it also is on the inner side.

CRINOIDEA.

ANTEDONIDÆ.

Antedon serripinna, *Carpenter*.

Several specimens of this species were dredged from a muddy bottom at a depth of 10 fathoms in Suez Bay. When living they were of a purplish-black colour, the arms of one specimen being regularly striped with yellow.

The cirri consist of twenty-three ossicles, of which all, from the fifth onwards, have a transverse dorsal ridge. As in the specimens of this species collected by Prof. Herdman off the coast of Ceylon, the ridge is near the distal end in the first few ossicles and becomes median in the later ones. In

the last few ossicles it is represented by a pair of parallel spines, and the penultimate one bears a strong opposing spine.

In relative size the proximal pinnules of the armlets resemble those of the specimens from Ceylon, but the number of pinnular ossicles is larger.

The second syzygy occurs at the ninth or tenth joint and the third at the fourteenth.

Distribution.—New Guinea, Tonga Islands, Ceylon, Red Sea.

Antedon parvicirra, *Carpenter*.

This species, originally discovered by the 'Challenger' in the neighbourhood of the Philippine Islands, is represented in Mr. Crossland's collection by one specimen, and it is, perhaps, the most interesting addition to the Crinoid fauna of the Red Sea made by him, especially as no other record of its occurrence has been made since the publication of Carpenter's Report on the Crinoidea of the 'Challenger' Expedition.

The type specimen has forty cirri, consisting of from ten to twelve ossicles; in the one under notice seventeen are actually present, but the number was originally not less than twenty, and may have been twenty-five. They consist of fourteen ossicles, of which the first and the penultimate are the shortest. The intervening ones are long and cylindrical, with enlarged ends, the fifth and sixth being the longest. The penultimate one bears a minute opposing spine.

The radials are not visible, except at the angles. The first primibrachs are very short and have a transverse furrow, deeper at the sides than in the median line, and are not in contact laterally; the second (axillaries) are pentagonal, wider than long, and have a backward projection into the slightly incised first primibrachs.

The first brachial is wedge-shaped and is just in contact with its fellow on the inner side of the armlet. The second brachial is twice the length of the first and slightly longer on the outer than on the inner side. The third and fourth brachials are together nearly square and are united by syzygy. Then there follow a number of wedge-shaped brachials which, as the tip of the armlet is approached, become obliquely quadrate, but alternately longer on one side than on the other.

In both branches of the left anterior arm the second syzygy occurs at the fifth joint, but in the others it is at the ninth. The third is at the fourteenth, and others follow between every third and fourth brachial with great regularity. The proximal pinnules have fewer ossicles than those of the type.

Locality.—Suez Bay, 10 fathoms, mud.

Antedon marginata, *Carpenter*.

With some little doubt I have referred to this species two small and imperfect specimens from the same locality as the foregoing. As in the type

specimen, which was obtained by the 'Challenger' off Manila, the centro-dorsal is a saucer-shaped disc, marked with cirrus-sockets almost to the centre of the dorsal surface, and bears seventeen cirri in an irregular row around its margin. These have fifteen to seventeen or even nineteen ossicles, which gradually increase in length from the first to the seventh, beyond which they are scarcely longer than broad and increasingly compressed, and have slightly carinate dorsal edges or even a minute dorsal spine.

In the specimens under notice the radials are distinctly visible, and are not in contact except at their proximal ends. In the type they are only just visible, but this point of difference is possibly due to the immature condition of the Suez specimens. The two primibrachs agree with those of the type.

The arms of one of these specimens branch once only; the other has two secundibrachs in one branch of each arm and, in the case of one arm, two tertiibrachs *. The third, eighth, and fourteenth joints are syzygies; others follow at intervals of four to five joints.

The proximal pinnules have fewer ossicles than those of the type. That of the second brachial has fourteen, and that of the fourth fourteen or fifteen. The next pinnule (fifth brachial) is little larger than that of the second, but has fifteen or sixteen ossicles; while that of the seventh brachial has eleven to twelve and is much smaller than that of the second.

Locality.—Suez Bay, 10 fathoms, mud.

ANTEDON IMPARIPINNA, *Carpenter*.

One specimen of this species was collected in Suez Bay and four in Suakim Harbour. In the former the dorsal surface of the centro-dorsal is simply flattened, but in the latter, especially the larger ones, it is concave, thus resembling the type.

In the Suez specimen the total number of armlets is twenty-seven; while those from Suakim have twenty-one, twenty-one, twenty-six, and thirty-three, respectively.

In the Suez specimen the second syzygy occurs at the seventeenth to the nineteenth joint, and others follow at intervals of eight to nine joints. In several of the arms of the specimens from Suakim, syzygies occur at the eighth and twelfth joints, and in several of the arms of the larger specimens the second syzygy is at the twentieth.

Colour in life, as noted by Mr. Crossland,—Suakim specimens: (*a*) purple and yellowish white; (*b*) brown and white; (*c*) light brown and white; (*d*) a uniform deep brown; Suez specimen, predominantly yellow. This last specimen had a brown commensal Polynoid living upon it. When taken from the water the tegmen and viscera were detached spontaneously.

Distribution.—Bay of Amboina, Tonga Islands, Batjan, Hongkong, New Guinea (*Hartlaub*), Red Sea.

* A more precise description of these specimens is not possible owing to their imperfect condition.

ANTEDON PALMATA (*Müller*).

This species has been long known from the Red Sea, Müller's original description being based upon specimens from that locality and from Ceylon. The specimens in Mr. Crossland's collection were obtained from the coral-reef of Misharif Island, Khor Dongola, and from between tide-marks at Suez, the collector at the latter place being C. Gordon Logan, Esq.

In the specimens from Misharif Island the ossicles of the calyx and the proximal brachials are of a dirty-white colour in spirit, and the armlets are alternately and broadly banded with the same colour and dark brownish grey. The dorsal and ventral faces of the cirri show the same contrast of colour. The single specimen from Suez is of a uniform purplish black.

Distribution.—Red Sea, Ceylon.

ANTEDON SAVIGNYI (*Müller*).

In two examples of this species obtained from a depth of 4 fathoms in Suez Bay the number of armlets is thirteen.

In both specimens the third and eighth brachial joints are syzygies, and others follow at irregular intervals of four to thirteen joints.

Colour in spirit: purple, with purplish-white cirri and almost white pinnules.

A single specimen obtained from a muddy bottom at a depth of 9 fathoms at Ul Shubuk was, when living, "whitish, with a violet tinge, and with patches of darker colour and of yellow." From it were taken "fifteen Ophiurids which lived with their arms twisted round those of the Antedon. The colour of these on the whole resembled that of their host."

This specimen has twenty armlets, each facet of the five primibrachial axillaries bearing a series of four secundibrachs, the fourth of which forms the axillary. The position of the second syzygy varies between the sixteenth and twentieth joints, and others follow at intervals of ten to twelve joints.

Of two specimens obtained from a depth of 10 to 12 fathoms at Khor Shinab, one when living was brown and white, the other purple and white. One has fourteen armlets and the other eighteen, some of the arms dividing once only. The second syzygy is in some cases at the fourteenth joint, but usually varies in position between the seventeenth to the nineteenth, and others follow at intervals of seven to nine joints.

A single specimen with twenty armlets was found living amongst coral at the anchorage at Salaka. Like one of those from Khor Shinab, its colour was brown and white.

Distribution.—Red Sea, Ceylon.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—VIII. The ALCYONARIANS. By Prof. J. ARTHUR THOMSON, M.A., and Mr. JAMES M. McQUEEN, M.A., B.Sc., University of Aberdeen. (Communicated by Professor HERDMAN, D.Sc., F.R.S., President.)

(PLATES 5–8 and 4 Text-figures.)

[Read 5th December, 1907.]

THIS collection of Alcyonarians was made in 1906 by Mr. Cyril Crossland, M.A., B.Sc., on and off the shores of the Red Sea, in the course of his investigation of the Sudanese marine fauna. The localities where he collected were :—Suakim, Khor Dongola, Mersa Makdah, Shubuk, Matala, Etuleh, Wadi Lehama, Kal el Kebira, Shab Baya, Rawaya, and Agig. The indefatigable collector has furnished us with a few notes as to the colour of some of the living animals.

The collection includes the following 26 species :—

I. STOLONIFERA.
- *Clavularia pulchra*, Thomson and Henderson.
- *Sympodium fulvum* (Forskål).
- *Tubipora purpurea*, Pallas.

II. ALCYONACEA.
- *Xenia umbellata*, Lamarck.
- „ *cærulea*, Ehrenberg.
- „ *fuscescens*, Ehrenberg.
- *Alcyonium sphærophorum* (Ehrenberg).
- *Sarcophytum glaucum*, Quoy et Gaimard.
- *Sclerophytum gardineri*, Pratt.
- „ *querciforme*, Pratt.
- „ *densum* (Whitelegge).
- *Lithophytum arboreum*, Forskål.
- „ *brassicum* (May).
- „ *thyrsoides* (Ehrenberg).
- „ *crosslandi*, n. sp.
- „ *macrospiculatum*, n. sp.
- *Nephthya zanzibarensis*, Thomson and Henderson.
- „ *albida* (Holm).
- *Spongodes hemprichi*, Klunzinger.
- „ *hartmeyeri*, Kükenthal.
- „ *suesiana*, n. sp.
- „ *pharonis*, n. sp.

III. PSEUDAXONIA.
- *Melitodes coccinea* (Ellis).
- „ *splendens*, n. sp.
- *Clathraria rubrinodis*, Gray.
- „ *acuta*, Gray.

Order I. **STOLONIFERA**, Hickson.

CLAVULARIA PULCHRA, *Thomson and Henderson* (1906).

See J. Arthur Thomson and W. D. Henderson: "Alcyonaria of Zanzibar and British East Africa from Collections made by Cyril Crossland," Proc. Zool. Soc. 1906, p. 405.

A large colony growing on a pearl-oyster shell and on the stone to which the shell is attached.

The polyps, which arise from a strong basal membrane, are large and substantial; the body varies from 10 to 30 mm. in length, and from 2 to 3·5 mm. in breadth; the tentacles are 5 to 10 mm. in length. There is a very marked hypostome, about 1 mm. high. There are 28 pinnules on each side of a tentacle, and they are for the most part very long and slender. In some cases, however, they are almost wart-like. This diversity depends in this case on the degree of contraction.

The whole surface of the colony glistens with calcareous rods; the following measurements were taken of their length and breadth in millimetres:—$0·054 \times 0·018$; $0·09 \times 0·02$.

Locality.—Khor Dongola, 10 fathoms; previously recorded from Zanzibar shore.

SYMPODIUM FULVUM (*Forskål*).

=*Lithophyton fulvum*, Forskål (1775).
Sympodium fulvum, Ehrenberg (1884).
See W. May: "Beiträge zur Systematik und Chorologie der Alcyonaceen," Jenaische Zeitschr. Naturwiss. xxxiii. (1899) p. 52.
W. Kükenthal: "Ueber einige Korallenthiere des roten Meeres," Festschrift von E. Haeckel, 1904, p. 41.

A large number of specimens seem to be referable to this species, the only noteworthy difference from the type being that the general spicules of the cœnenchyma are not visible to the naked eye. A characteristic feature is the armature of the polyp-body, which consists of eight double rows of spicules arranged in chevron, and with some horizontally disposed spicules at the bases of the rows. According to Kükenthal, this type should be referred to *Alcyonium*.

Locality.—Very abundant about Matala Island in Khor Dongola, one of the richest pearling shallows. Previously recorded from the Red Sea and East Africa (Tumbatu).

TUBIPORA PURPUREA, *Pallas.*

The differences between alleged different species of *Tubipora* remain in a very unsatisfactory stage of definition. Emphasis has been laid, for instance, on the number of pinnule-rows. But our specimen shows with equal clearness polypes whose tentacles have a single row on each side, and polyps whose tentacles have a double row on each side. The difference is in this case due

to the different degrees of contraction, and is therefore of no significance. We have referred the specimen to Pallas's species, *T. purpurea.* From this it does not seem to us that *T. chamissonis* can be separated.

Many of the polyps are crowded with spherical or nearly spherical reproductive bodies, most of which show an internal cavity and a wall with several layers of nuclei. The following measurements of diameters were taken in millimetres: $0{\cdot}0765 \times 0{\cdot}0765$; $0{\cdot}136 \times 0{\cdot}1445$; $0{\cdot}296 \times 0{\cdot}296$; $0{\cdot}323 \times 0{\cdot}323$; $0{\cdot}34 \times 0{\cdot}351$. These will form the subject of subsequent study, along with other bodies of a similar nature which occur in various Alcyonarians. They are either young embryos or sperm-sacs.

Locality.—Outer edge of the reef (Shubuk). Previously recorded from the Red Sea, from Zanzibar (as *T. chamissonis*), and from East Indies (as *T. chamissonis*).

Order II. **ALCYONACEA**, Verrill.

Xenia umbellata, *Lamarck.*

Numerous colonies with whitish-brown stems and chocolate-brown polyps. Many of the groups are 50 mm. in height, the stem being about 30 mm., and the polyp-bearing region about 20 mm. A common size of polyp is 10–12 mm., the tentacles and the polyp-body being each 5–6 mm. in length. The polyp-bodies and tentacles are thickly covered with glistening calcareous corpuscles. These are arranged in 8 very distinct longitudinal rows on the polyp-body. Every here and there one observes what looks with low power like a perforation about a millimetre in diameter and with a perfectly regular contour. These pore-like spots are dense colonies of zoochlorellæ. There are on each side of the tentacles four rows of long pinnules, about 18–20 in each row. There are abundant ova.

While the description just given applies to a large number of colonies, there are many others which differ markedly, *e. g.* in being much smaller, in showing no spicules or almost none, in having some reddish colour, in the number of rows of pinnules, in the total number of pinnules, and in the length of the pinnules. After a careful examination of a large number of specimens, we have come to the conclusion that these are all referable to a very variable species.

A specimen from the outer part of Suakim Harbour has a peculiar reddish colour, which Mr. Crossland noted as "not natural"; but it may be recalled that Klunzinger observed a rusty brown on the inner side of the tentacles. In this specimen the body of the polyp is about 10 mm. in length; the tentacles are about 8 mm. in length; there are slender, elongated, pointed pinnules in 2–3 rows about 12 in each row. There are very abundant zoochlorellæ, and there is not the slightest trace of effervescence when the polyp is dropped into dilute hydrochloric acid.

In the living colonies there was considerable difference in coloration :—(*a*) whitish stems, bluish tentacles, grey pinnules ; (*b*) whitish-brown stems, chocolate-brown polyps ; (*c*) whitish zooids, chocolate-brown tentacles.

Some of the colonies which seem referable to this variable species show only two rows of pinnules on each side of the tentacles, and greatly elongated tentacles appear as if they only had one row. It was easy to find tentacles with three rows of 20 pinnules, or two rows of 30 pinnules. This matter of rows of pinnules is a very untrustworthy and useless character. Young polyps occur at the bases of those fully-formed, and show various stages from minute zooid-like buds on which no tentacles are visible with low power, to small forms with distinct tentacles and pinnules, but only about a tenth the size of the ordinary polyps. Over and over again we have thought for a time that we had to do with a clear case of dimorphism of zooids, but further examination has shown that there were transitions between minute polyps showing *no* tentacles and others not much larger which exhibited them. Moreover, in colonies apparently identical in every other respect with those showing minute zooids without tentacles, no such zooids could be found.

Localities.—Various parts of Suakim Harbour, 1–2 fathoms. Previously recorded from Red Sea, Mozambique, Tumbatu, Zanzibar, Ceylon, Pacific Ocean (New Britain).

XENIA CÆRULEA, *Ehrenberg*.

A small specimen growing on a coral fragment presents some difficulty. The polyps are about 3·5 mm. in height, the tentacles are about the same. On each side of the tentacle there are 16–20 pinnules, in 2–3 rows or in one. The two lowest pinnules are small, but it cannot be said that there are two kinds of pinnules. The extended pinnules are elongated, slender, and pointed.

The tentacles and the bodies of the polyps show large numbers of zoochlorellæ. In some cases the colour remained bright green. Under low power the surface had a glistening appearance, as if dusted with refractive particles. These are zoochlorellæ, not spicules. The calcareous corpuscles are very minute and by no means abundant. The specimen may be referred to Ehrenberg's *X. cærulea*, or, what comes almost to the same thing, it may be regarded as a dwarf variety of *X. umbellata* *. In another specimen the number of pinnules on each side was 24 in two rows, the whole surface glistened with zoochlorellæ, and no effervescence was seen when the polyp was placed in dilute acid.

Locality.—Off S.E. corner of Shubuk, 9 fathoms ; bottom of coarse sand, shells, and coral. Etuleh shoals in Suez Bay.

* It seems certain that *X. umbellata*, Lamarck, *X. fuscescens*, Ehrenberg, and *X. cærulea* Ehrenberg, are very closely related. It may be necessary eventually to unite them in one variable species.

XENIA FUSCESCENS, *Ehrenberg.*

Several colonies, showing two sizes of zooids, are referable to this species, which is closely related to *X. umbellata*, Savigny.

The larger zooids have bodies up to 18 mm. in length, with tentacles about half as long. There are about 40 long slender pinnules on each side, in two rows. There are abundant zoochlorellæ.

The small zooids are 2–4 mm. in height. They show minute tentacles, but no pinnules.

Locality.—Suakim Harbour, ½ fathom. Previously recorded from the Red Sea, Zanzibar.

ALCYONIUM SPHÆROPHORUM (*Ehrenberg*).

See C. B. Klunzinger: Die Korallthiere des rothen Meeres, Part I. Die Alcyonarien, etc., 1877, p. 22.
W. May, 1899, *loc. cit.* p. 105.

The collection includes numerous specimens of this common species. In their mode of growth they more nearly resemble *A. pachyclados,* but their spicules are nearest those of *A. sphærophorum.* We see no reason for regarding these as distinct species, and we would suggest the incorporation of the former in the latter.

We are inclined to think that *A. globuliferum*, Klunzinger, *A. digitulatum,* Klunzinger, and *A. brachyclados*, Ehrenberg, should be referred, along with *A. pachyclados*, to one species—*A. sphærophorum.* As described and figured, they do not seem to us to differ in more than slight quantitative characters, which are probably not more than individual fluctuations. The specimens here referred to *A. sphærophorum* furnish *all the kinds of spicules* figured as distinctive of *A. globuliferum*, *A. digitulatum*, and *A. brachyclados,* though the most prevalent agree with those figured as distinctive of *A. sphærophorum.* The colour of the living specimens was “ like weak cocoa ” with “ chocolate ” tentacles. This corresponds with Ehrenberg's “ polypis fuscis.”

Twelve species of *Alcyonium* have been reported from the Red Sea; but there is no doubt that the list will have to be much reduced.

Locality.—From the coral shoal of Kal el Kebira in Suez Bay. Previously recorded from Red Sea, Madagascar.

SARCOPHYTUM GLAUCUM, *Quoy et Gaimard.* (Plate 5. fig. 5.)

See E. von Marenzeller: “ Ueber die *Sarcophytum* benannten Alcyoniiden,” Zool. Jahrb. i. (1886) p. 352, Taf. ix. figs. 1 & 2.

The collection includes several specimens of this species.

A typical colony consists of a stout trunk, 1·5 cm. high by 4·7 cm. broad, somewhat concealed by the overhanging much folded lobes of the capitulum. The upper surface of the capitulum is about 11·5 cm. in breadth, and the appearance presented by the convoluted and dovetailed lobes has been compared to that of a Meandrine Coral.

The autozooids are large and well-marked. Towards the periphery of the capitulum they are closely aggregated in rows parallel to the free border, the individuals of adjacent rows alternating. Towards the centre of the capitulum they become sparser. A converse distribution of the siphonozooids is to be noted.

Towards the centre the siphonozooids are very numerous; as many as 6 to 13 can be counted in a straight line between two adjacent autozooids: peripherally only 1 to 3.

The spicules agree with Marenzeller's figures.

The following measurements were taken of length and breadth in millimetres:—

Cortical spicules from the lobes of the capitulum:

Clubs: 0·22 × 0·06; 0·175 × 0·025; 0·15 × 0·025; 0·13 × 0·04; 0·1 × 0·015.

Rods: 0·35 × 0·025; 0·29 × 0·025; 0·26 × 0·02; 0·21 × 0·025; 0·15 × 0·015.

Spindles: 0·27 × 0·03; 0·52 × 0·03; 0·22 × 0·04; 0·17 × 0·02; 0·15 × 0·02; 0·075 × 0·02.

Spicules from the autozooids:

Rods: 0·28 × 0·02; 0·27 × 0·02; 0·26 × 0·02; 0·25 × 0·02; 0·21 × 0·01.

Cortical spicules from the trunk:

Tuberculate spindles: 0·8 × 0·15; 0·8 × 0·12; 0·78 × 0·16; 0·74 × 0·12; 0·68 × 0·14; 0·62 × 0·12; 0·55 × 0·15; 0·5 × 0·1; 0·47 × 0·075; 0·44 × 0·06; 0·45 × 0·075; 0·35 × 0·075.

Slightly spinose spindles: 0·39 × 0·04; 0·34 × 0·04; 0·32 × 0·04; 0·3 × 0·06; 0·15 × 0·03.

Clubs: 0·24 × 0·06; 0·2 × 0·05; 0·18 × 0·05; 0·15 × 0·03; 0·12 × 0·05; 0·1 × 0·04.

Smooth spindles: 0·4 × 0·04; 0·275 × 0·03; 0·23 × 0·03; 0·22 × 0·02; 0·12 × 0·04.

The colour in spirit is light to medium brown. Mr. Crossland notes that the colour of the living colonies was greenish brown, but that the tentacles were white in some. Consequently the fully expanded colony, seen from above, often appeared white.

Locality.—Suakim Harbour; growing in proximity to coral, Sherm Shekh. Previously recorded from Australia, Red Sea, Tonga Island, Viti Island, Maldive Islands.

SCLEROPHYTUM GARDINERI, *Pratt.*

See E. M. Pratt: "The Alcyonaria of the Maldives," in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, ii. (1903) p. 527.

Several specimens belonging to this species illustrate how a colony becomes gradually more complex in its structure with increased growth. A young colony is represented by an elliptical mass 7·5 cm. by 5·5 cm.; from its

upper surface lobes arise to a height varying from 0·5 mm. to 7 mm. The smaller lobes are wart-like. An older colony, shaped like a half-moon, carries on its convex upper surface several lobes, the largest attaining a height of 2 cm.; these lobes have numerous digitate branches up to 7 mm. in length with a breadth of about 4 mm.

The spicules agree closely with the description given by Miss Pratt (Alcyonaria of the Maldives, p. 527), and consist of clubs which average 0·06 to 0·1 mm. in length by 0·02 to 0·06 mm. in breadth, and spindles 0·16 to 0·2 mm. in length by 0·06 mm. in breadth.

The tuberculate spicules are about 3 mm. long and 0·8 to 1 mm. broad.

The colour of a colony in spirit is light to dark brown; during life it was dull chocolate.

Locality.—Very abundant locally in reef gaps due south of Shubuk. Previously recorded from the Maldives.

SCLEROPHYTUM QUERCIFORME, *Pratt.* (Plate 8. fig. 1.)

See E. M. Pratt, 1903, *loc. cit.* p. 530.

Several fine colonies of this species are included in the collection. The specimen photographed (Pl. 8. fig. 1) has a short wrinkled and furrowed trunk, somewhat compressed laterally.

The branches come off rather abruptly from the stem and pass almost imperceptibly into a much branched capitulum.

As the photograph suggests, the colonies tend to be more complex than Miss Pratt's figure (Alcyonaria of the Maldives, pl. xxxi. fig. 33) would lead one to suppose.

The spicules of the capitulum are very various, comprising tuberculate spindles similar to those of the trunk though smaller, spinose spindles and clubs.

The following measurements were taken of length and breadth in millimetres:—

Spinose spindles: $0·32 \times 0·03$; $0·28 \times 0·03$; $0·25 \times 0·03$; $0·18 \times 0·02$.
Clubs: $0·23 \times 0·02$; $0·22 \times 0·03$; $0·2 \times 0·04$; $0·18 \times 0·02$; $0·015 \times 0·04$; $0·14 \times 0·04$; $0·12 \times 0·03$; $0·08 \times 0·03$.

The spicules of the trunk are tuberculate spindles, rarely forked, besides clubs and spinose spindles. The tuberculate spicules vary greatly in size, the largest being about 5 mm. by 0·7 mm.

The following are the measurements of the colony represented in the photograph:—Breadth of trunk at base, 3·5 cm.; breadth of capitulum, 8·5 cm.; height of capitulum, 4·5 cm.

The colour of the colony in spirit is light to dark brown; when alive it was purple-slate.

Locality.—Off south-east corner of Shubuk, at a depth of 9 fathoms, on a bottom of coarse sand, shells, and coral. Previously recorded from the Maldives.

Sclerophytum densum (*Whitelegge*).

= *Lobophytum densum*, Whitelegge.

See Th. Whitelegge, "The Alcyonaria of Funafuti," Mem. Australian Mus. 1897, p. 219, pl. xi. figs. 4 *a*–4 *h*.

See E. M. Pratt, 1903, *loc. cit.* p. 521, pl. xxix. fig. 18, pl. xxx. figs. 20–22.

This species is represented by two very hard and brittle colonies. The trunk of one colony is 7·5 cm. broad and 5·8 cm. high. It passes almost imperceptibly into numerous finger-like processes. What we have observed in these specimens corresponds closely with Miss Pratt's figures (Alcyonaria of the Maldives, 1903).

Whitelegge (1897) has classified the spicules very minutely, and his subdivisions have been followed in taking the following measurements of length and breadth in millimetres :—

i. Large fusiform, with simple spine-like tubercles and usually with a transverse median constriction : $2·5 \times 0·5$; $2·1 \times 0·4$; $2 \times 0·4$.

ii. Large fusiform, subcylindrical or subclavate, closely tuberculate, the tubercles being thickly studded with minute spiny warts : $3·1 \times 0·5$; $2·7 \times 0·5$; $2·3 \times 0·45$; $1·9 \times 0·4$.

iii. Smaller fusiform, strongly but distantly tuberculate : $0·75 \times 0·25$; $0·6 \times 0·2$.

iv. Small fusiform, comparatively smooth, but with some spines : $1 \times 0·18$; $0·48 \times 0·1$.

v. Spindles : $0·22 \times 0·04$; $0·19 \times 0·04$; $0·17 \times 0·03$; $0·06 \times 0·03$.

vi. Clubs : $0·12 \times 0·04$; $0·08 \times 0·04$.

The colour of the colony in spirit is pale yellow ; when living it was bluish-grey.

Locality.—Forms great sheets in about four feet of water in Suakim Archipelago (Tella Tella Seghir Island). Previously recorded from Funafuti, China Seas, British New Guinea, the Maldives.

Lithophytum arboreum, *Forskål.*

For descriptions, see W. May (1899), *loc. cit.* p. 134, and W. Kükenthal, "Versuch einer Revision der Alcyonarien. II. Die Nephthyiden, 1 Teil," Zool. Jahrb. 1903, p. 124.

A large number of specimens are referable to this species. There is considerable variety as regards the dimensions of the spicules, and some forms approach *L. stuhlmanni*.

One of the largest specimens consists of a common basis 7 cm. in breadth, from which six branches take origin. These bear secondary branches on

which the polyps are thickly clustered in catkins. A typical branch separated from the common basis corresponds closely to the figure given by Klunzinger (1877).

In more than one specimen we found no trace of spicules, but as these specimens were badly preserved we suppose that some acid had been accidentally added to the preservative.

Localities.—Suez; Coral shoal of Kal el Kebira in Suez Bay; Khor Abu Hamama, 10 fathoms, muddy bottom. Previously recorded from Red Sea, Zanzibar, New Britain.

LITHOPHYTUM BRASSICUM (*May*). (Plate 5. fig. 4.)

See W. May, 1899, *loc. cit.* p. 139, fig. 22. W. Kükenthal, 1903, p. 120.

We have figured (Pl. 5. fig. 4) a specimen which agrees in essential features with *Lithophytum brassicum*, though it is somewhat divergent in its mode of growth and general appearance. It is fixed to a piece of Millepore and rises to a height of 20 mm., with a maximum breadth of 55 mm. It shows about sixty subglobose heads, each bearing about a score of polyps which are deeply retracted. The colour is a dull light brown.

Locality.—Edge of leeward reef, Suakim Archipelago, Tella Tella Kebira. Previously recorded from Zanzibar.

LITHOPHYTUM THYRSOIDES (*Ehrenberg*).

= *Ammothea thyrsoides*, Ehrenberg. See W. Kükenthal, 1903, *loc. cit.* p. 109.

Several fine specimens of this common species are included in the collection. They consist of a common basis from which cylindrical stalks rise parallel to one another. The polyps arise directly from the ends of the stalks. The spicules of the stalks and polyps are very slender transparent spindles with few warts.

The following measurements were taken of length and breadth in millimetres:—

(*a*) Polyp-spicules: $0{\cdot}3 \times 0{\cdot}01$; $0{\cdot}28 \times 0{\cdot}01$; $0{\cdot}2 \times 0{\cdot}01$; $0{\cdot}15 \times 0{\cdot}01$; $0{\cdot}12 \times 0{\cdot}01$; $0{\cdot}1 \times 0{\cdot}1$; $0{\cdot}05 \times 0{\cdot}01$.

(*b*) Stem-spicules: $0{\cdot}46 \times 0{\cdot}02$; $0{\cdot}37 \times 0{\cdot}02$; $0{\cdot}35 \times 0{\cdot}02$; $0{\cdot}27 \times 0{\cdot}02$; $0{\cdot}2 \times 0{\cdot}01$.

The colour of the preserved specimens is yellowish-brown; in life they were dull brown.

Locality.—Outer Park of Suakim Harbour. Previously recorded from Red Sea, Indian Ocean (Tumbatu), Zanzibar.

LITHOPHYTUM CROSSLANDI, n. sp.

A common stem, 2 cm. broad and 1·5 cm. high, gives origin to four limp branches showing longitudinal furrows. These branches are 13, 12, 9, and 7 cm. in length respectively, and carry secondary branches on which the

polyp-bearing twigs are clustered. The p lyp-bearing twigs are in the form of catkins with a length of from 0·5 to 1·5 cm. The basal catkins are stouter and more closely beset with polyps than the upper.

A notable diagnostic feature is the presence of rows of closely aggregated small granular spicules in the tentacles, and continued on to the polyp-head and polyp-stalk.

More spicules are to be found in the cortex of the stem than in the cortex of the main branches; consequently the stem is somewhat more rigid. The spicules of the cortex include spindles with large spines; the spindles are sometimes curved, and the spines are in some cases longer on the convex surface; there are also spindles with few warts, irregular spinose bodies and bicuspids, *i. e.* with two prongs or cusps.

The following measurements were taken of length and breadth in millimetres :—

Spinose spindles : 0·72 × 0·2 ; 0·55 × 0·13 ; 0·52 × 0·1 ; 0·45 × 0·1 ; 0·37 × 0·12 ; 0·33 × 0·15 ; 0·29 × 0·12.

Spindles with few warts : 0·42 × 0·05 ; 0·375 × 0·1 ; 0·37 × 0·1 ; 0·35 × 0·075 ; 0·35 × 0·1 ; 0·29 × 0·03 ; 0·25 × 0·1 ; 0·23 × 0·05.

Bicuspids : 0·47 × 0·275.

The canal walls contain highly spinose spindles, spindles with small warts, highly spinose club-shaped bodies, irregular spinose bodies, and bicuspids.

The following measurements were taken of length and breadth in millimetres :—

Highly spinose spindles (the spines being larger on the convex side) : 0·52 × 0·12 ; 0·4 × 0·075 ; 0·37 × 0·11 ; 0·35 × 0·1 ; 0·3 × 0·1 ; 0·3 × 0·15.

Spindles with small warts : 1·02 × 0·22 ; 0·95 × 0·2 ; 0·85 × 0·175 ; 0·52 × 0·12 ; 0·32 × 0·1.

Highly spinose club-shaped bodies : 0·32 × 0·15 ; 0·275 × 0·175.

Bicuspids : 0·42 × 0·175.

Mr. Crossland notes that the specimen appeared whitish under water, pale brown when brought up.

Locality.—From a depth of three or four feet in the Coral-reef of Khor Delaweb.

Lithophytum macrospiculatum, n. sp. (Plate 8. figs. 2 & 3.)

From a stem rather less than 1 cm. high, with a breadth of 2·5 cm., three primary branches take origin. One of these, after a course of half a centimetre, divides dichotomously into two branches of 4 and 5 cm. in length respectively. The other primary branches are 6 and 4 cm. in length.

Polyps are not borne either on the main stem or on the main branches, but

on secondary branches and the twigs which spring from these. The secondary branches are crowded closely on the primary and form catkins 1·5 to 2·5 cm. in length, the larger catkins being of a compound character.

In the cortex of the terminal polyp-bearing branches there is a longitudinal arrangement of the spindle-shaped spicules, and this is continued on to the dorsal surface of each polyp-stalk.

The polyp-heads are bent sharply on the polyp-stalks, so that the tentacular surface faces the cortex of the terminal twigs.

The cortical spicules of the stem and main branches form by interlacing a continuous armature. These spicules are of very diverse and distinctive forms, including the following :—

(*a*) Boat-shaped spindles with few warts.
(*b*) Curved spindles with long spines, which are more developed on the convex surface.
(*c*) Very spinose club-like forms.
(*d*) Triradiate spinose bodies.
(*e*) Irregular spinose bodies.

The following measurements were taken of length and breadth in millimetres :—

(*a*) Boat-shaped spindles : 0·8 × 0·15 ; 0·75 × 0·075 ; 0·67 × 0·1 ; 0·62 × 0·1 ; 0·5 × 0·075 ; 0·45 × 0·09.
(*b*) Curved spindles : 0·95 × 0·15 ; 0·85 × 0·12 ; 0·8 × 0·15 ; 0·73 × 0·15; 0·7 × 0·1 ; 0·65 × 0·15 ; 0·52 × 0·13 ; 0·5 × 0·1.
(*c*) Club-like forms : 0·33 × 0·25.

The spicules of the polyp-head and polyp-stalk include long curved or sinuous spindles with knob-like warts which in some cases are more numerous and better developed at the tips of the spindles ; also spindles with only a few poorly developed spines.

The following measurements were taken of length and breadth in millimetres :—

(1) Spinose spindles : 1·5 × 0·1 ; 1·15 × 0·1 ; 1·1 × 0·12 ; 0·6 × 0·05 ; 0·4 × 0·05 ; 0·2 × 0·02.
(2) Smooth spindles with only a few spines : 1·2 × 0·09 ; 0·9 × 0·05 ; 0·69 × 0·05.

The spicules of the canal walls consist of spindles similar to those of the cortex, but the form with few spines predominates.

The following measurements were taken of length and breadth in millimetres :—

(1) Spinose spindles : 0·87 × 0·12 ; 0·85 × 0·12 ; 0·83 × 0·12 ; 0·6 × 0·1 ; 0·55 × 0·13 ; 0·5 × 0·1.

(2) Smooth spindles with only a few spines: $1·02 \times 0·15$; $0·72 \times 0·15$; $0·6 \times 0·075$; $0·55 \times 0·075$; $0·42 \times 0·1$; $0·4 \times 0·05$; $0·275 \times 0·04$; $0·2 \times 0·05$.

The colour of the colony in spirit is light yellow.

Locality.—Khor Dongola.

NEPHTHYA ZANZIBARENSIS, *Thomson and Henderson.*

See Thomson and Henderson, 1906, *loc. cit.* p. 421, pl. xxvii. fig. 3.

A specimen which seems to be referable to this species differs from the type in being distinctly more rigid; that is to say, more densely filled with spicules.

Locality.—Engineer Island, Khor Dongola. Previously recorded from Wasin Channel, Zanzibar.

NEPHTHYA ALBIDA (*Holm*).

= *Spongodes albida*, Holm.

See O. Holm: "Beiträge zur Kenntniss der Alcyoniden-Gattung *Spongodes*," Zool. Jahrb. viii. (1895) p. 30, 3 figs.

See Kükenthal, 1903, *loc. cit.* p. 160.

A specimen which seems referable to this species differs from the type in having the polyp-body covered with very numerous small spicules without definite arrangement in double rows. In other words, the larger polyp-spicules arranged in chevron are not represented. In including *Nephthya jagerskioldi* with *Spongodes savignyi*, Kükenthal notes the same kind of variation which we believe to have occurred here, namely a replacement of fewer larger spicules on the part of the polyp-wall by more numerous smaller spicules. This cannot be regarded as of systematic importance.

Locality.—Suakim Harbour. Previously recorded from the Red Sea.

SPONGODES * HEMPRICHI, *Klunzinger.*

See Klunzinger, 1877, *loc. cit.*

Kükenthal, 1904, *loc. cit.*

Kükenthal: "Versuch einer Revision der Alcyonarien. II. Die Familie der Nephthyiden, 2 Teil," Zool. Jahrb. xxxi. (1905) pp. 503–726, 7 pls. & 61 figs.

Several colonies in the collection are evidently referable to a group of species which Kükenthal speaks of as closely allied, namely, *S. hartmeyeri*, *S. mayi*, *S. klunzingeri*, *S. ehrenbergi*, and *S. hemprichi*.

* According to Kükenthal, the generic name *Spongodes* should be replaced by another, and he suggests *Dendronephthya*; see page 74.

I. The specimens differ superficially from *S. hartmeyeri*:

(1) in being much more ramified and crowded colonies;

(2) in the absence of any trace of foliate lower branches;

(3) in their colour-scheme, which is due to the thick covering of crimson spicules. As to the colour of the living specimen, Mr. Crossland notes that it appeared jet-black when seen through a fathom or two of clear water, but when brought up it showed a splendid dark crimson, shading into pink on the stem.

They differ more intimately in the following points:

(1) The anthocodial spicules are arranged in 8 rows of 5–7 converging pairs; they converge but slightly and are more or less longitudinal in *S. hartmeyeri*. Moreover, the uppermost spicules of the double rows do not project beyond the anthocodia as they do in *S. hartmeyeri*.

(2) The tip of the main "Stützbündel" spicule is smooth, while in *S. hartmeyeri* the same spicule is most spinose towards the free tip.

(3) They differ in the dimensions and direction of the spicules in the cortex of the main branches. In *S. hartmeyeri* the cortex is densely filled with large, very thick, finely spinose spindles up to $5 \times 0{\cdot}5$ mm. They seem from the drawing to be longitudinally arranged. In the specimens in this collection the spindles are for the most part arranged transversely to the long axis of the branches.

The following measurements of these spindles were taken in length and breadth in millimetres: $2 \times 0{\cdot}12$; $1{\cdot}8 \times 0{\cdot}1$; $0{\cdot}65 \times 0{\cdot}05$.

II. The specimens differ superficially from *S. mayi*:

(1) in the absence of the rigidity and brittleness characteristic of a species developed in one plane. The colonies in this collection have a well-developed bare trunk up to 7·5 cm. in length. In one specimen the stem divides somewhat dichotomously into two main divisions; in another specimen, four main branches take origin abruptly. From the main branches secondary branches arise in every plane.

(2) The branching is more profuse and the clusters of polyps are much denser than in *S. mayi*.

(3) The colour-scheme is golden yellow in *S. mayi*.

They differ more intimately from *S. mayi*:

(1) in the absence of a greatly developed projecting spicule at the end of each double row of spicules on the anthocodiæ;

(2) in the fact that only one "Stützbündel" spicule projects beyond the polyp-head; the tip of the "Stützbündel" spicules is *smooth*, like that of the chief "Stützbündel" spicules in *S. mayi* ;

(3) in the disposition of the superficial cortical spicules, which are predominantly longitudinal in *S. mayi* ; and

(4) in the character of the spicules of the cortex, which are curved spindles, while in *S. mayi* there are, in addition to spindles, clubs, four-rayed spicules, and irregular bodies.

III. The specimens differ superficially from *S. klunzingeri* :

(1) since that species is for the most part developed in one plane with an almost suppressed trunk ;

(2) in the mode of branching and in the disposition of the polyps in crowded bundles of 6–11 in each bundle, whereas in *S. klunzingeri* they are only 1–3 in a bundle.

They differ more intimately :

(1) in the nature and arrangement of the anthocodial spicules, which in *S. klunzingeri* are in rows of 8–10 with the uppermost two very much longer ;

(2) in having an entirely different "Stützbündel" made usually of two spicules ; and

(3) inasmuch as the spicules of the canal-walls are broad and flat spinose spindles.

In the specimens the spicules of the canal-walls are varied and may be grouped as follows :

(A) spindles of undulating contour, or halfmoon-shaped, or tending to be club-shaped ;

(B) spindles forked at one end (bicuspids), transitional to triradiates ;

(C) triradiate forms ;

(D) irregular bodies with four arms, probably derived from C. All spinose.

IV. The colonies have a great superficial resemblance to *S. ehrenbergi*, but differ from it in having 6–11 polyps in each bundle, while *S. ehrenbergi* has 5–8.

They differ more intimately :

(1) inasmuch as *S. ehrenbergi* has only 4–5 pairs of spicules in each double row, each about 0·3 mm. in length, the uppermost 0·5 mm. with long oblique spines ;

(2) in the nature of the projecting spicules of the "Stützbündel," which in *S. ehrenbergi* has a spinose tip, whereas in these specimens the tip is smooth ;

(3) in the spicules of the cortex of the main branches, which do not include any clubs or oval spinose bodies;

(4) inasmuch as from the canal-walls of *S. ehrenbergi* only spindles are reported.

V. The specimens agree with *S. hemprichi* in the following respects:

(1) There are 5–7 pairs of anthocodial spicules in each double row and the uppermost pair project very slightly. It is to be noted, however, that the number of paired spicules on the two rows on the *ventral* surface of the polyp-head may be as few as two pairs.

(2) The projecting spicule of the "Stützbündel" has a smooth tip.

(3) The spicules of the canal-walls are, on the whole, similar. In *S. hemprichi* there are curved spindles, triradiates, and small bodies beset with several prongs.

(4) The spicules of the cortex are arranged transversely.

(5) The polyp-spicules are blood-red and the polyps yellowish.

The only difference between Crossland's specimens and those described by Kükenthal lies in the general architecture, which is well represented by Kükenthal's drawing of *S. ehrenbergi*. They may be referred to the *arborescens* type of *S. hemprichi*, which Kükenthal describes as transitional between the glomerate and the divaricate mode of branching.

Another specimen which is superficially very unlike the above, but closely resembles Klünzinger's figure of *Spongodes hemprichi*, is in its details so like what we have described that we cannot but refer it to the same species, which, therefore, includes two distinct modes of growth—that figured by Klunzinger and the *arborescens* type of Kükenthal.

A case like this leads us to feel the precariousness of a classification which attaches much importance to modes of branching.

Locality.—Shab Baya, near Rawaya. Previously recorded from Red Sea.

SPONGODES HARTMEYERI, *Kükenthal.*

Two small rigid whitish colonies seem to be referable to this species, but differ in having no coloured spicules and in having rougher "Stützbündel" spicules. They are probably young colourless forms.

Locality.—Khor Dongola. Previously recorded from the Red Sea.

SPONGODES SUESIANA, n. sp. (Plate **5**. fig. 1.)

A brownish-yellow interesting colony of apparently glomerate type. It resembles in general architecture Kükenthal's *Spongodes* (*Dendronephthya*) *clavata* (see Versuch einer Revision der Alcyonaceen. Die Nephthyiden, 2te Teil,

Taf. 26) ; but in the nature of the projecting "Stützbündel" spindle and in the number and arrangement of the spicules on the anthocodia it closely approaches *S. mayi*. It seems to belong to the group of allied species referred to under *S. hemprichi*.

There is a somewhat flattened flexible stem, longitudinally furrowed, 8·5 cm. in length and 1 cm. in breadth. The cortex of the stem shows well-marked transverse striations due to the underlying spindles.

Small polyp-bearing twigs spring from the stem, somewhat sparsely below, more thickly above, so that the apex of the stem is completely hidden by polyp-bundles.

From the stem there arise at irregular intervals secondary branches whose length decreases in a somewhat graduated fashion. The following measurements of the length of the various branches from below upwards on the stem serve to indicate this feature: 2 cm.; 1·75 cm.; 1·5 cm.; 1 cm. These secondary branches bear polyp-bearing twigs in thick clusters. The polyps are in bundles of from 6 to 12 or even more.

The "Stützbündel" consists of 2 to 4 spindles, one of which projects 0·4 mm. or more beyond the anthocodia. This spindle is spinose below with a smooth tip. Of the projecting "Stützbündel" spicules, which are generally of a yellow colour, the following measurements were taken (length and breadth in millimetres) :—$2·3 \times 0·1$; $2·4 \times 0·1$. The tip is smooth for 0·35 mm.

On the anthocodia there are eight double rows of converging spicules with from 6 to 9 in each row. One spicule of the uppermost row, or occasionally both, may project for 0·2 mm. beyond the anthocodia. Thus Kükenthal's figure of an anthocodia of *S. mayi* (see Ueber einige Korallentiere des roten Meeres, Taf. v. fig. 20) exactly represents what may be seen occasionally in this species, except that only one projecting "Stützbündel" spicule is the rule and not two as figured.

When both spicules of the uppermost row project, they lie almost parallel to each other in sharp contrast to the pairs below, which converge at a right or a slightly obtuse angle.

The tentacles are without spicules. The colour of the anthocodial spicules ranges from red to yellow.

The spicules of the upper cortex consist of spindles, clubs, bicuspids, with an occasional triradiate form. They are very spinose, not merely along the margins, but on every surface; and are colourless or tinged with yellow.

The following measurements were taken of length and breadth in millimetres :—

Spindles: $1·7 \times 0·1$; $1·4 \times 0·1$; $0·95 \times 0·075$; $0·8 \times 0·05$; $0·75 \times 0·075$; $0·7 \times 0·075$; $0·6 \times 0·05$; $0·5 \times 0·05$; $0·25 \times 0·02$.

Clubs: $0·75 \times 0·1$; $0·4 \times 0·1$.

Bicuspids: $0·6 \times 0·075$.

Triradiates: each arm, $0·3 \times 0·2$.

The spicules of the lower cortex do not differ from those of the upper cortex in form or colour.

The following measurements were taken of length and breadth in millimetres :—

Spindles : 0·75 × 0·075 ; 0·7 × 0·1 ; 0·65 × 0·05 ; 0·6 × 0·05 ; 0·5 × 0·03 ; 0·4 × 0·05 ; 0·3 × 0·03 ; 0·1 × 0·03.

Clubs : 0·6 × 0·1 ; 0·4 × 0·1 ; 0·3 × 0·1 ; 0·35 × 0·075 ; 0·3 × 0·075.

The canal-walls are without spicules.

Some other specimens agreed with the above in general structure, in the nature of the "Stützbündel," in the armature of the anthocodia, in the spicules of the cortex, and so on. Thus one could not but admit that all the colonies belonged to the same species, and yet it was impossible to say that the polyps were really grouped in bundles, which is one of the diagnostic features of the genus *Spongodes*. In some cases they were arranged on a terminal branch in a catkin-like or spike-like manner. This was the rule in one specimen.

It may be noted that Kükenthal admits that certain specimens were intermediate in this respect between *Spongodes* and *Nephthya*, and consequently difficult to place.

The point to be noted in these colonies is that, though obviously all of the same species, yet they differ in a generic feature !

If we take a composite view of all the specimens this species combines the characteristics of both *Spongodes* and *Nephthya*. Yet the colony described in detail must be placed in the glomerate division of the genus *Spongodes*. Within that division it seems to represent a new species.

Locality.—Suez Bay.

Spongodes pharonis, n. sp. (Plate **5**. figs. 2 & 3.)

Several colonies of the umbellate type, agreeing with Kükenthal's *rubra*-group in having branches of approximately equal length, with the upper surface practically even. They differ from any of the species of *Spongodes* hitherto described from the Red Sea—viz. : *S. savignyi*, *S. hemprichi*, *S. klunzingeri*, *S. arborea*, *S. mayi*, *S. hartmeyeri*, and *S. ehrenbergi*—in possessing the following combination of diagnostic characters :—

a. The umbellate development of the colony.

b. The absence of spicules on the tentacles.

c. The absence of spicules in the canal-walls.

d. The occasional presence of a strongly developed spine or sometimes of two spines projecting prominently beyond a corymb of polyps, greatly exceeding in diameter and in length the "Stützbündel" spicule or spicules which project beyond the anthocodia of each polyp.

The colonies show in each case a substantial trunk which at a distance of 2·5 cm. or less from its base is embraced by a collar of foliate lower branches. These leaf-like branches bear sessile polyps scattered round their margin, while further on the upper surface may be seen twigs, which divide in the corymbose fashion characteristic of the whole colony. These twigs also carry polyps on their tips.

From the angle between the rising stem and the collar spring one or two branches equal in size to those that are terminal. These branches in their turn break up into terminal corymbs. Beyond the collar, the stem after a short course divides into two or three main branches, which soon divide up into secondary branches supporting the terminal corymbs. The terminal corymbs are all brought more or less to the same level, so that the upper surface of the polyparium is somewhat flattened. A polyp-bundle usually comprises 3 to 8 individual polyps, but the number is very variable.

The polyp-head is bent more or less at a right or an acute angle to the polyp-stalk. The polyp-head is 0·8 mm. in length and 0·55 mm. in breadth. The polyp-stalk is about 1 mm. in length. The anthocodial spicules are in rows of 3 to 5 pairs, the uppermost of which do not project beyond the anthocodia.

The angle of each chevron is a very acute one, giving a somewhat longitudinal direction to the spicules of the anthocodia.

Some variation in colour is to be noted in the anthocodial spicules. In one of the colonies they are colourless, in another red, while transitional pinkish spicules are present in a third colony. In the "Stützbündel" there may be one or two projecting spicules. These spicules show very small serrations regularly disposed. Their tip may be quite smooth or with an occasional serration. Their colour varies from a light yellow to a reddish yellow.

The following measurements were taken of these spicules (length and breadth in millimetres) :—$1·5 \times 0·03$; $1·25 \times 0·1$; $0·8 \times 0·03$; $0·7 \times 0·03$. In some of the colonies the size of the projecting "Stützbündel" spicules approaches nearer to the dimensions of the stout spines which are a feature of the terminal corymbs. These strong spines, which seem to protect and support the polyps on a terminal corymb, generally arise independently of an individual polyp, but sometimes they simply take the place of the normal but smaller "Stützbündel" spicule.

Of these stouter spindles the following measurements were taken (length and breadth in millimetres) :—$4 \times 0·25$; $4 \times 0·2$; $3·5 \times 0·15$; $3·5 \times 0·125$. The tentacles are oblong with a few pinnules and without spicules.

The cortex of the upper branches contains slightly curved spindles with very fine and regularly disposed serrations.

The following measurements of these spindles were taken (length and breadth in millimetres) :—$4 \times 0·2$; $3·2 \times 0·1$; $1·4 \times 0·5$; $1 \times 0·03$. Their colour in one specimen is white with a yellowish tinge, in three specimens

red, but amongst the red spindles are some with intermediate light-pink shades.

Their distinctive feature lies in the remarkably fine serration of the edges of the spindles. This is a constant feature no matter what their dimensions or colour may be.

The lower cortex contains markedly spinose irregular bodies, often somewhat star-shaped, very spinose spindles, spinose clubs, spinose triradiates, spinose bicuspids.

The following measurements were taken of length and breadth in millimetres :—

Spinose spindles : $1 \times 0{\cdot}1$; $0{\cdot}75 \times 0{\cdot}1$; $0{\cdot}4 \times 0{\cdot}12$; $0{\cdot}33 \times 0{\cdot}1$; $0{\cdot}3 \times 0{\cdot}11$; $0{\cdot}25 \times 0{\cdot}1$; $0{\cdot}23 \times 0{\cdot}075$.
Spinose triradiates : $0{\cdot}5$; $0{\cdot}33$; $0{\cdot}3$ = length of the three arms.
Spinose bicuspids : $0{\cdot}75 \times 0{\cdot}1$.
Spinose clubs : $0{\cdot}18 \times 0{\cdot}13$.

The canal-walls in every specimen are without spicules.

The colour of the colonies in spirit varies somewhat, the colour depending on that of the spicules. Where the spicules are red, the colony is reddish ; where there are a considerable number of white or light yellow spicules, the colony is proportionately lighter in tint.

Locality.—From a muddy bottom, at a depth of 12 fathoms, Mersa Abu Hamama, Sudan.

Order III. **PSEUDAXONIA**, G. von Koch.

MELITODES COCCINEA (*Ellis*) (=Isis coccinea, *Ellis*). (Plate **6**. figs. 1 & 2.)

The collection includes numerous specimens which are referable to Ellis's *Isis coccinea.* From Ellis's figure and description there can be almost no doubt that he referred to forms like the present specimens, which must, however, be referred to the genus *Melitodes.*

The specimens are of a brilliant crimson or scarlet colour, and there is one yellow fragment. The most frequent mode of branching is that figured by Ellis,—a broad fan, with dichotomous branches almost all in one plane, and without anastomosis. In other specimens, however, the branches do not spread out in a broad fan, and anastomosis is frequent. The colonies stand erect, reaching a height of 4 cm. and a breadth of 2–4 cm. In some cases colonies grew so close to one another that their bases formed a continuous sheet. Solitary colonies show most clearly the typical fan-like form.

The internodes, which curve slightly in different planes, vary in length from 5–10 mm. The nodes are very short, 1–2 mm., and are not distinctly marked in the intact colonies. On the thinner twigs the verrucæ are mostly along the edges, and a somewhat flattened appearance thus results. On the

thicker branches they occur practically all over. They stand out somewhat prominently to a height of about 0·5 mm., and appear as widely open crater-like elevations or as rounded hillocks according to the state of contraction.

The whole surface of the colony is seen under the lens to be rough with spindle-shaped spicules, all of a red colour.

The spicules of the cœnenchyma are: (1) substantial tuberculate spindles, of which the following measurements were taken:—$0·3 \times 0·07$, $0·27 \times 0·09$ mm. The tubercles are large and blunt. In some cases the ends of the spindles are irregularly bifid. There are also some slender curved tuberculate spindles. (2) Short compact fusiform types covered with numerous blunt tubercles: $0·124 \times 0·05$ mm. (3) Club-shaped forms or "Stachelkeulen" with irregularly shaped tuberculate heads. From these through torch-like forms there are transitions to irregular spindles. The clubs are frequently 0·23 mm. in length by 0·1 mm. in breadth across the head. In the polyps there are minute and slender red spindles, besides a number of minute slightly tuberculate curved rodlets which are practically colourless. For both of these types a common length is 0·04 mm. The aboral surface of the tentacles bears about 5 large red spicules arranged in chevron. The axis shows longitudinal canals.

Locality.—From the sides of a buoy in Suez Bay, and on the coral-reef of Engineer Island, Khor Dongola.

MELITODES SPLENDENS, n. sp. (Plate 7. figs. 1 & 2.)

Numerous broken pieces of a bright orange-red Melitodid. They seem to represent several colonies. The nature of the spicules and the presence of longitudinal canals in the axis indicate the genus *Melitodes*, but we have not been able to refer the specimens to any of the numerous previously described species.

One of the pieces has a breadth of 6 mm. across an internode about 3 cm. above the base, while a node about the same height has a breadth of 9 mm. The length of the internode at this level is 11 mm., and towards the base of the colony the internodes have an average length of about 12 mm. The branching is profuse, with many anastomoses, but is mainly confined to one plane. An attempted reconstruction of the broken specimens leads one to infer that the colonies may have been about 25 cm. in height. The terminal branches are about 1 mm. in thickness.

The verrucæ are almost confined to one surface of the branches. They are somewhat scattered on the basal parts, but towards the ends their bases are in contact. They are slightly flattened hemispheres. The retracted polyp is just seen as a whitish spot on the top of the verruca.

The axis shows numerous longitudinal canals in the nodes and internodes. A thin section through a thick internode showed about ten. On the surface of the axis there is external fluting corresponding to the course of the canals in the cœnenchyma.

The spicules, which are mostly yellowish, include :—

(*a*) Narrow tuberculate spindles of various sizes, *e.g.* 0·15 × 0·018 mm., 0·108 × 0·03 mm.

(*b*) Short broad spindles with tubercles at each end and in two whorls between, *e.g.* 0·04 × 0·025 mm.

(*c*) Fusiform types intermediate between (*a*) and (*b*) with sharper tubercles.

(*d*) A few non-foliate clubs, *e.g.* 0·055 × 0·028 mm. across the head.

(*e*) Some pale yellow or almost colourless rods, sometimes almost straight and smooth, often with a median prominence on each side, often slightly curved at the ends, *e.g.* 0·096 × 0·012 mm.

The generic distinctions of the Melitodidæ are not very satisfactory, but we may note that the absence of foliaceous clubs, the presence of some small nodular spicules in the cortex, and the canals in the axis point to *Melitodes.*

Locality.—Mersa Abu Hamama, from a muddy bottom, at a depth of 10 fathoms.

* CLATHRARIA RUBRINODIS, *Gray.* (Plate 6. figs. 3 & 4.)

See Gray: Proc. Zool. Soc. London, 1859, p. 486; Catalogue of Lithophytes in the British Museum, 1870, p. 11, 1 fig.

=*Mopsea bicolor,* Kölliker, Icones Histologicæ, p. 142, 1 fig.

It is interesting to find in this collection the peculiar Melitodids to which Gray gave the names *Clathraria rubrinodis* and *C. acuta.* It is rather remarkable that such striking forms have not been more frequently collected. Apart from Gray's brief descriptions, we have found no reference to *Clathraria.*

The larger species, *C. rubrinodis,* is represented by a specimen about 12 cm. in height, which was probably the upper part of a large colony. This is suggested by the size of some of the fragments found in the same vessel.

The branching is mainly in one plane, and there is abundant anastomosis. The branches arise almost invariably from the nodes. There is a strong tendency to dichotomy, and the two branches diverge at a wide angle at their common origin. This gives a very characteristic appearance, which is increased by the fact that each of the cylindrical branches is of uniform width throughout its length, and terminates bluntly, or may, indeed, be slightly thicker at the tip than at its origin. The smaller twigs show a much less marked tendency to dichotomy, and some of them narrow towards the

* The account of *Clathraria rubrinodis* and *C. acuta* was prepared by Miss Doris L. Mackinnon as part of a thesis for the degree of B.Sc. in the University of Aberdeen.

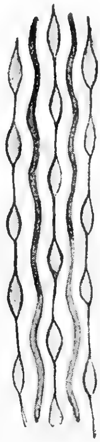
end, which is always truncate. The stouter branches have a diameter of 4 mm.; the more slender twigs of 2 mm.

The preserved specimens have a dirty cream-colour, frequently tinged with pale sulphur-yellow along one side of a branch and near the tips of the twigs. In the living specimens the colour was bright light yellow, with dull red joints. The specific name *rubrinodis* has reference to the dark-red horny nodes, which shine indistinctly through the whitish cœnenchyma, or appear as bright red patches where a branch has been broken away.

The internodes are of very unequal lengths, varying from 7 to 32 mm.; the calcareous axis, stripped of cœnenchyma, has a diameter of 1–3 mm., and is white with a tinge of sulphur-yellow here and there. The longer branches may have as many as seven internodes; the shorter branches and the twigs consist of only one piece.

Fig. 1.

Fig. 2.



Clathraria rubrinodis, Gray.
Fig. 1. Spicules. Fig. 2. Details of calcareous joints.

On the surface of the white calcareous axis there is a characteristic sculpturing due to longitudinal furrows. There are two sets of these furrows which alternate with one another. One set is deeper than the other and of equal width throughout. The shallower furrows are constricted at regular intervals, and the broad portions of one shallow furrow lie between the constrictions of the similar furrow on either side. In these broad ovals the polyps appear to be set.

There are no nutritive canals in the axis. A longitudinal section shows that the axis is built up of minute spindle-shaped spicules, fused together, and arranged with their long axes in the line of the long axis of the branch.

The nodes are much shorter than the internodes (3–4 mm.) and are somewhat thicker. They are composed of a dark-red horny substance, which, under the microscope, appears as a yellowish network with numerous red spindle-shaped spicules in the meshes.

It occasionally happens that a branch arises from an *internode* ; in such cases the first joint is horny.

The cream-coloured cœnenchyma is crowded with small spicules. Most of these are white, but some are tinged with yellow or yellowish green. Spiny clubs and more warty double-clubs and dumb-bells are very abundant. Spindles bearing numerous very minute warts are less common, and simple spindles are rare.

The following measurements were taken of length and breadth in millimetres:—

Clubs: $0{\cdot}136 \times 0{\cdot}084$; $0{\cdot}153 \times 0{\cdot}059$; $0{\cdot}119 \times 0{\cdot}051$.
Double clubs: $0{\cdot}042 \times 0{\cdot}034$; $0{\cdot}067 \times 0{\cdot}055$; $0{\cdot}051 \times 0{\cdot}042$.
Spindles: $0{\cdot}187 \times 0{\cdot}051$; $0{\cdot}119 \times 0{\cdot}025$.
Red spindles of nodes: $0{\cdot}102 \times 0{\cdot}017$; $0{\cdot}085 \times 0{\cdot}017$; $0{\cdot}068 \times 0{\cdot}002$.

The small polyps are spirally arranged almost uniformly all round the branches. They are nearly all retracted, lying almost flush with the surface of the cœnenchyma. Besides the substantial anastomosis, there may be a more superficial fusion of cœnenchyma when one branch lies against another.

Locality.—Coral-reef, Mersa Makdah, Shubuk.

CLATHRARIA ACUTA, *Gray*. (Plate 7. figs. 3 & 4.)

See Gray: Catalogue of the Lithophytes in the British Museum, 1870, p. 12.

This species is represented by two specimens, one of 7 cm. and the other of 5 cm. in height. The mode of growth is tree-like and graceful. The branches, much more slender than in *C. rubrinodis*, are cylindrical and of very uniform width until close to their end, when they narrow abruptly into a sharp apex.

In the larger specimen there is a main stem, which gives off two long branches on one side, two long and three short on the other, and then bifurcates at the top. The side branches also show dichotomy. Of the seven branches four arise from the internodes. The other specimen is branched dichotomously throughout and the branches arise from the nodes. On the whole the branching is in one plane. There may be fusion of branches, but not nearly to the same extent as in *C. rubrinodis*.

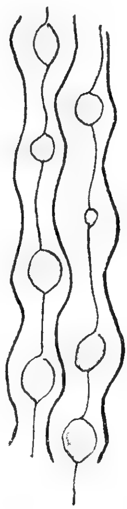
The colour of the preserved specimens is a delicate flesh-pink, marked by

darker red patches where the nodes shine through the semi-transparent cœnenchyma. The living colonies were pink.

The calcareous internodes vary from 10 mm. to 17 mm. in length, and are about 2 mm. in diameter They are marked longitudinally by sinuous furrows which expand at intervals into little round pits. The colour of the axis shades from deep rose-red to pink.

Fig. 3.

Fig. 4.



Clathraria acuta, Gray.

Fig. 3. Spicules. Fig. 4. Details and ornament on calcareous joints.

Microscopic examination shows that the axis is composed of numerous spindles fused together, with their long axes in line with the long axis of the branch. The nodes are dark red, much shorter than the internodes, and slightly swollen ; they are composed of a yellowish horny network enclosing short red spindles.

The pinkish-white cœnenchyma is semi-transparent and very delicate. The polyps are not nearly so numerous as in *C. rubrinodis*, but are larger in proportion and project from the surface as minute warts. They seem to correspond in position to the cup-shaped pits in the axis of the internodes, and their arrangement is very markedly spiral.

The spicules of the cœnenchyma are spiny and tuberculate clubs and warty double-clubs with a few spindles and boomerangs. They are, on the whole, rather smaller than in *C. rubrinodis* and distinctly less spiny. The majority are colourless, but many show a red or pink tinge.

Locality.—Khor Dongola, near the group of Islets; rock bottom, $9\frac{1}{2}$ fathoms.

Note on the Genus Clathraria, *Gray.*

In 1859 Gray gave a brief description of his genus *Clathraria* as represented by *C. rubrinodis*. In 1870 he referred the genus to the family Mopselladæ and distinguished another species, *C. acuta*.

Gray's diagnosis of *Clathraria* is as follows:—" Coral shrub-like; branches cylindrical, erect, tortuous, interosculating, of nearly *equal thickness*; branchlets, some free, blunt. Bark thin, granular. *Cells small, immersed, nearly equally scattered on all sides of the branches*; buds and branches from the swollen joints; joints elongate, white, longitudinally striated; internodes red, spongy."

Gray identified his *C. rubrinodis* with Kölliker's *Mopsea bicolor* ('Icones Histologicæ,' p. 142). Kölliker defined his genus *Mopsea* thus:—" Axis without nutritive canals. Spicules generally as in *Melithæa*, but without the beautiful foliaceous clubs. Length of the clubs 0·12–0·25 mm.; length of the larger polyp-spindles 0·18–0·34 mm." Of *M. bicolor* he says:—" Soft joints red, hard joints white with green centre. Cœnenchyma white to sulphur-yellow, with uneven surface. Thickness of axis 4–7 mm."

In the 'Challenger' Report (1899) Wright and Studer separate *Clathraria* from *Mopsea*, and give the following definition:—" Cylindrical manifoldly curving branches often anastomosing, and of uniform thickness throughout. The polyps are sunk in the cœnenchyma. The axis includes no nutritive canals. Spicules in cortex, broad and short foliaceous clubs."

In subsequent literature we find no further mention of *Clathraria*, though it is a very conspicuous and characteristic type. It is so unlike other Melitodids that its retention as a distinct genus seems desirable.

The specimens from the Red Sea are clearly referable to *Clathraria* and to the species *C. rubrinodis* and *C. acuta*. We are thus able to give the habitats of these two forms, which Gray was unable to do. The note in the 'Challenger' Report that the spicules are " broad and short foliaceous clubs" must have crept in by some mistake.

The definitions which Gray gave of *Clathraria* and *Mopsea* hardly justified him in his wide separation of the two genera, which he referred to different families. He makes no mention of the form of the spicules, and he says that the branches arise in both from the soft joints.

Kölliker's *Mopsea* is separated from his *Melithæa* by having no foliaceous clubs. His definition of *Mopsea*, so far as it goes, would cover both *Mopsea* and *Clathraria*.

In the 'Challenger' Report the genus *Mopsea* is re-constructed, and if the definition there given be considered more satisfactory than Kölliker's, then it is necessary to continue to keep *Clathraria* apart from *Mopsea*. It is noted, for instance, as a characteristic of *Mopsea* that the branches arise mostly from the internodes, whereas in *Clathraria* they arise mostly from the nodes.

The spicules of *Mopsea* are described as "finely-spined, unsymmetrical scales, slightly notched at the edge ; the spicules of *Clathraria* are spiny and tuberculate clubs, warty double-clubs, and spindles with very minute warts." For these and other reasons we think that *Clathraria* may be usefully retained as a distinct genus.

Provisional List of Red Sea Alcyonarians.

Those included in Mr. Crossland's collection are marked with an asterisk. The names in *square* brackets indicate the authorities for occurrence in the Red Sea. In other cases the authority for the species is also the authority for its occurrence in the Red Sea.

Order I. **STOLONIFERA.**

**Clavularia pulchra*, Thomson & Henderson.
Clavularia strumosa, Ehrenberg.
Clavularia glauca (Savigny).
**Sympodium fulvum*, Forskål [Klunzinger] [Kükenthal] = (according to Kükenthal) *Alcyonium fulvum* (Forsk.).
Sympodium cæruleum, Ehrenberg. [Klunzinger] [Kükenthal].
Anthelia uliginosa (Ehrb.) [Kükentnal] = (according to Kükenthal) :
- *Sympodium fuliginosum*, Ehrenberg [Klunzinger].
- *Sympodium purpurascens*, Ehrenberg [Klunzinger].
- *Anthelia glauca* (Ehrb.) [Klunzinger].
- *Anthelia strumosa* (Ehrb.) [Klunzinger].

**Tubipora purpurea*, Pallas [Klunzinger].
Tubipora hemprichi, Ehrenberg [Klunzinger].

Order II. **ALCYONACEA.**

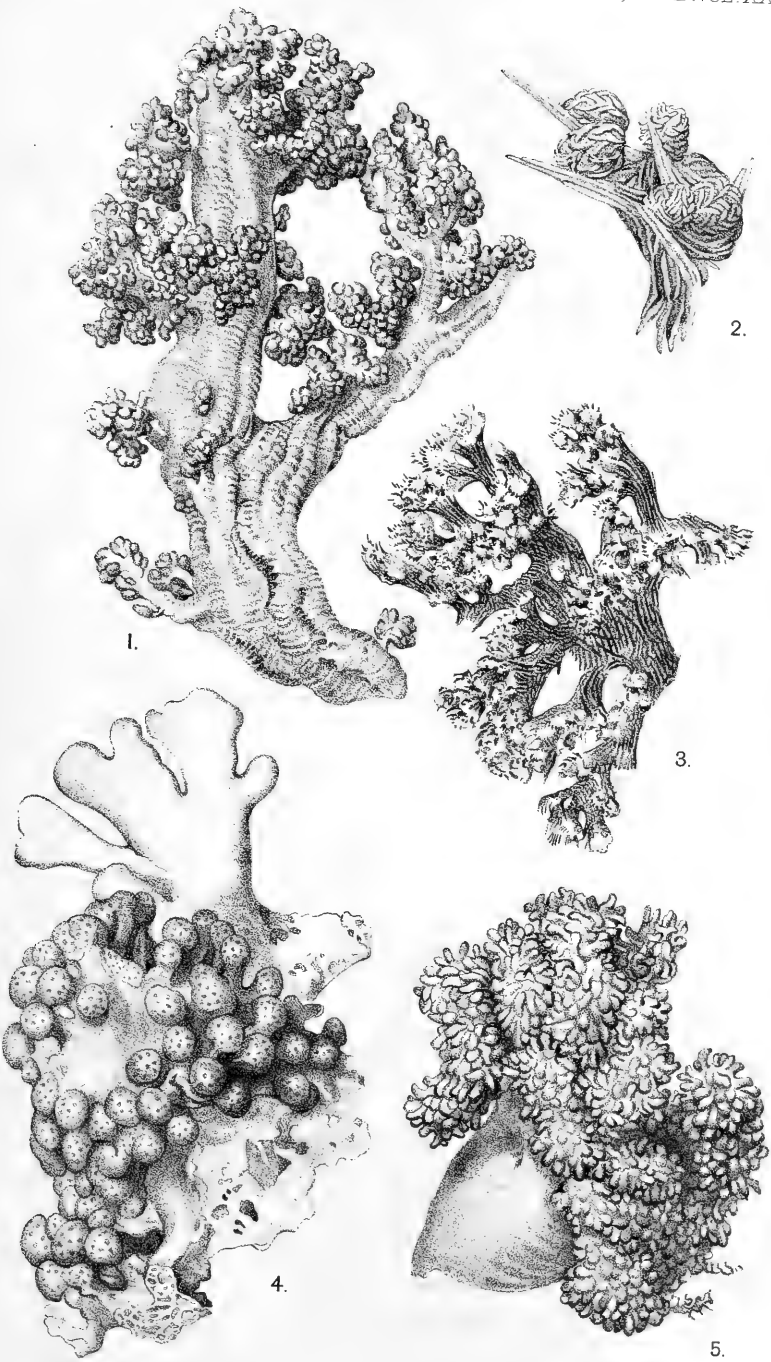
**Xenia umbellata*, Savigny [Klunzinger] [Kükenthal].
**Xenia fuscescens*, Ehrenberg [Klunzinger] [Kükenthal].
**Xenia cærulea*, Ehrenberg [Klunzinger].
Xenia blumi, Schenk [May].
**Alcyonium sphærophorum*, Ehrenberg [Klunzinger].
Alcyonium globuliferum, Klunzinger.
Alcyonium digitulatum, Klunzinger.
Alcyonium pachyclados, Klunzinger.
Alcyonium brachyclados, Klunzinger.
Alcyonium polydactylum, Dana [Klunzinger].
Alcyonium leptoclados [Klunzinger].
Alcyonium gyrosum, Klunzinger.

Alcyonium pauciflorum, Ehrenberg.
Alcyonium polydactylum, Ehrenberg.
Alcyonium rubiformis, Ehrenberg.
Alcyonium aurum, Gray.
Alcyonium elegantissimum, May.
**Sarcophytum glaucum*, Quoy & Gaimard.
Sarcophytum pulmo, Haeckel [Klunzinger].
Sarcophytum pauciflorum [Klunzinger].
Sarcophytum savignyi, Klunzinger.
Sarcophytum ehrenbergi, Marenzeller.
Sarcophytum trocheliophorum, Marenzeller.
**Sclerophytum gardineri*, Pratt.
**Sclerophytum querciforme*, Pratt.
**Sclerophytum densum* (Whitelegge).
Lobophytum pauciflorum, Ehrenberg.
**Nephthya zanzibarensis*, Thomson & Henderson.
**Nephthya albida* (Holm).
Nephthya chabrolii, Milne-Edwards & Haime [Klunzinger].
**Lithophytum thyrsoides*, (Kükenthal) = *Ammothea thyrsoides*, Ehrenberg [Klunzinger].
**Lithophytum arboreum*, Forskål [Klunzinger].
**Lithophytum brassicum* (May).
**Lithophytum crosslandi*, n. sp.
**Lithophytum macrospiculatum*, n. sp.
**Spongodes* † *hemprichi*, Klunzinger [Klunzinger] [Kükenthal].
**Spongodes hartmeyeri*, Kükenthal [Kükenthal].
**Spongodes suesiana*, n. sp.
**Spongodes pharonis*, n. sp.
Spongodes savignyi, Ehrenberg (Klunzinger) [Kükenthal].
Spongodes ramulosa, Gray [Klunzinger].
Spongodes klunzingeri, Studer [Kükenthal].
Spongodes arborea, May [Kükenthal].
Spongodes mayi, Kükenthal.
Spongodes ehrenbergi, Kükenthal.

Order III. **PSEUDAXONIA.**

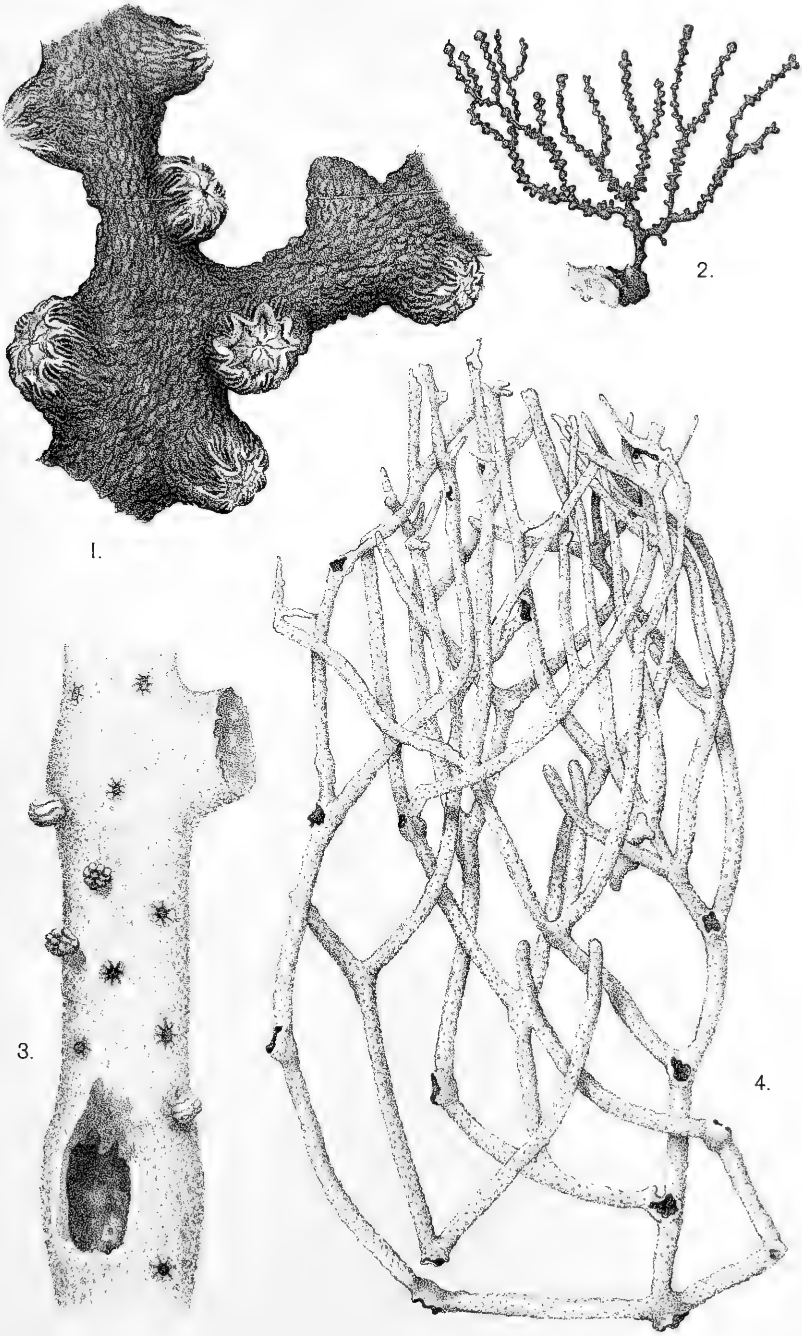
**Melitodes coccinea* (Ellis) = *Isis coccinea*, Ellis.
**Melitodes splendens*, n. sp.

† According to Prof. Kükenthal, who has revised this genus, the old name *Spongodes* should be changed to *Dendronephthya*. To us this appears neither necessary nor desirable.



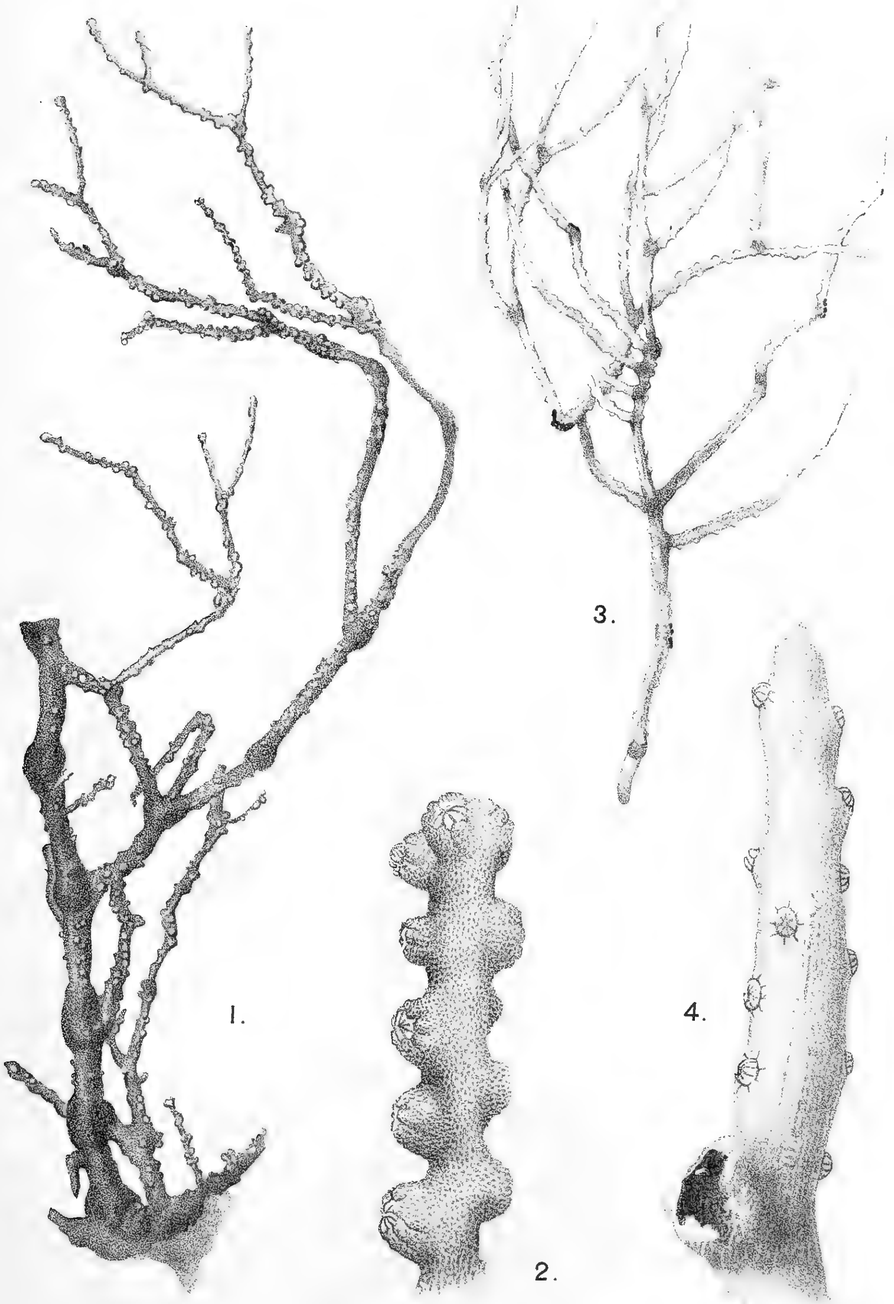
E. Wilson, lith. & imp.

SUDANESE ALCYONARIA.



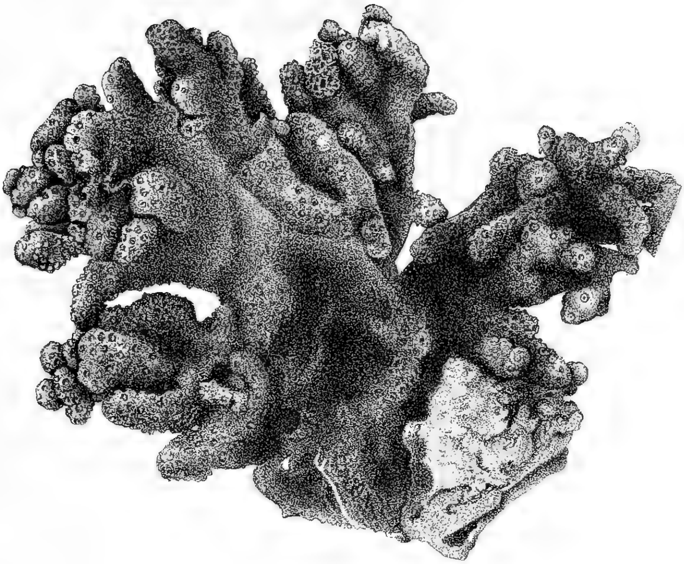
E. Wilson, lith. & imp.

SUDANESE ALCYONARIA.



E. Wilson, lith. & imp.

SUDANESE ALCYONARIA.



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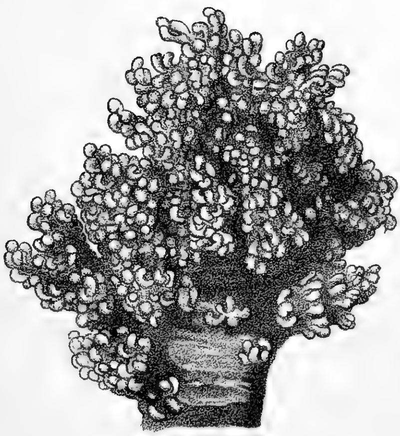

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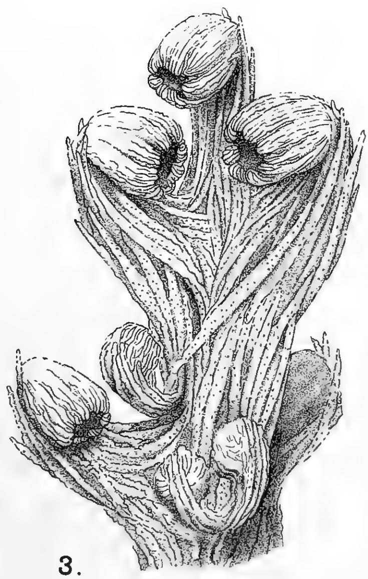


3.

E. Wilson, lith. & imp.

SUDANESE ALCYONARIA.

Mopsella erythracea, Gray [Klunzinger = *Mopsea erythræa*].
**Clathraria rubrinodis*, Gray.
**Clathraria acuta*, Gray.
Siphonogorgia mirabilis, Klunzinger.

Order IV. **AXIFERA.**

Caligorgia verticillata.
Plexaura antipathes, Kölliker [Klunzinger].
Plexaura torta, Klunzinger.
Verrucella flexuosa (Lamarck) [Klunzinger].
Juncella gemmacea, Kölliker [Gray] [Klunzinger].
Juncella hepatica, Klunzinger.

EXPLANATION OF THE PLATES.

Plate 5.

Fig. 1. *Spongodes suesiana*, n. sp. Nat. size.
2. *Spongodes pharonis*, n. sp. A small bundle of polyps. × 10.
3. *Spongodes pharonis*, n. sp. Nat. size.
4. *Lithophytum brassicum* (Kükenthal). Nat. size.
5. *Sarcophytum glaucum*, Quoy & Gaimard. Nat. size.

Plate 6.

Fig. 1. *Melitodes coccinea* (Ellis). × 12.
2. *Melitodes coccinea* (Ellis). Nat. size.
3. *Clathraria rubrinodis*, Gray. × 7.
4. *Clathraria rubrinodis*, Gray. Nat. size.

Plate 7.

Fig. 1. *Melitodes splendens*, n. sp. × 12.
2. *Melitodes splendens*, n. sp. × 12.
3. *Clathraria acuta*, Gray. Nat. size.
4. *Clathraria acuta*, Gray. × 7.

Plate 8.

Fig. 1. *Sclerophytum querciforme*, Pratt. Nat. size.
2. *Lithophytum macrospiculatum*, n. sp. × 2.
3. *Lithophytum macrospiculatum*, n. sp. A cluster of polyps. × 14.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—IX. ALGÆ.

By R. J. HARVEY-GIBSON, M.A., F.L.S., Professor of Botany, University of Liverpool.

[Read 5th December, 1907.]

THE following notes are the result of an examination of a small collection of Marine Algæ made by Mr. Crossland during 1904 and 1905, while engaged in investigations on the Sudan Marine Fauna, under the direction of Professor W. A. Herdman, F.R.S. Professor Herdman has handed me the collection for identification and report.

The plants were collected chiefly in the neighbourhood of Suakim and Trinkitat, and include 35 species, of which 12 belong to the Chlorophyceæ, 12 to the Phæophyceæ, and 11 to the Rhodophyceæ. In addition, 4 species of marine or brackish-water Phanerogams occur among the Algæ, and are given in an Appendix.

I am greatly indebted to Dr. M. Foslie, of Trondhjem, Dr. Reinhold, of Itzehoe, and to Mrs. Gepp for aid in identification of some of the calcareous and other forms both among the Rhodophyceæ and Chlorophyceæ, and also to the officials of the Cryptogamic Department of the Natural History Museum for aid rendered to me during a brief visit to the Museum for the purpose of identifying some of the more critical forms.

In addition to records of Algæ of the Indian Ocean and East Africa in more general works such as those of Agardh, Engler, Harvey & Sonder, &c., the following papers, dealing more especially with the forms occurring in the Red Sea and its immediate vicinity, have been consulted :—

ZANARDINI : "Plantarum in Mari Rubro hucusque collectarum enumeratio" (Mem. dell' I. R. Ist. Veneto, 1858).

PICCONE : "Contribuzioni all' Algologia Eritrea" (Nuov. Giorn. Bot. Ital. 1883).

HAUCK : "Ueber einige von J. M. Hildebrandt in Rothen Meere und in Indischen Ocean gesammelte Algen" (Hedwigia, 1886–89).

CHLOROPHYCEÆ.

1. CAULERPA RACEMOSA, *J. Ag.*, var. UVIFERA, *J. Ag.* ; *Weber van Bosse, Monographie des Caulerpes* (*Ann. Jard. Buitenz.* 1898, p. 362).

This variety was dredged in 2–3 fathoms off Suez. It is recorded from

the Red Sea by Agardh, from Suez by Zanardini, and from the Somaliland Coast by Piccone.

2. Caulerpa peltata, *Lam.*, f. typica ; *Weber van Bosse, in Ann. Jard. Buitenz.* 1898, p. 375.

Collected on coral-reefs at Khor Dongola, Suez. Recorded by Zanardini, under the name of *C. chemnitzia*, var. *peltata*. It is not recorded by Piccone.

3. Halimeda incrassata, *Lam.*, f. monilis, *Bart.* ; *E. S. Barton, The Genus* Halimeda, *Monogr.* lx. *of the Siboga Expedition*, 1889–1900.

Dredged at 2–3 fathoms at anchorage off Suez. Recorded by Zanardini, under the name of *H. monile*, from Suez, Akaba, and Kosseir.

4. Halimeda Opuntia, *Lam.*, f. triloba, *Bart.*

Collected in shallows in Suakim Harbour.

5. Halimeda Opuntia, *Lam.*

The plant here referred to seems intermediate in character between the f. *typica* and f. *cordata* of Barton's Monograph. This identification is on the authority of Dr. Reinbold.

6. Avrainvillea lacerata, *J. Ag.*

Suez Bay. Recorded from the same locality by Zanardini, under the name of *Chloroplegma sordidum.*

7. Avrainvillea papuana, *G. Murr. et Boodle.*

Suakim. This is a Malayan and Indian Ocean species, not recorded in any of the Red Sea lists above referred to.

8. Udotea argentea, *Zan.*

Mud-flats in Suez Bay. Recorded and figured by Zanardini as a new species. The present plant agrees in all respects with Zanardini's figure and description, as was pointed out to me by Mrs. Gepp.

9. Dictosphæria favulosa, *Decne.*

This form occurred along with sponges forming large patches on the sands at Khor Dongola. It is recorded as *Valonia favulosa*, Ag., from the Red Sea by Zanardini and by Piccone.

10. Codium tomentosum, *Kütz.*

One small and somewhat mangled plant was found attached to *Lithophyllum affine* (34). It was unmistakably, however, *C. tomentosum*, which has been recorded by several authors from the Red Sea.

11. Bryopsis plumosa, *Kütz.*

Suakim and Trinkitat.

12. Enteromorpha compressa, *Grev.*

Suez Bay and Suakim.

PHÆOPHYCEÆ.

13. Sargassum dentifolium, *J. Ag.*; *J. G. Agardh, Spec. Sarg. Austr.* p. 101.

Dredged from Trinkitat Harbour. One of the most common *Sargassa* in the Red Sea. Recorded both by Zanardini and Piccone from Suez, Akaba, Tor, &c.

14. Sargassum latifolium, *J. Ag.*; *J. G. Agardh, l. c.* p. 103.

Dredged from 9 fathoms in Suez Bay. Recorded by Zanardini from the same locality. Hauck records a var. *zanzibarica* from the Somaliland Coast, but the present plant agrees more closely with the type itself.

15. Sargassum crispum, *Forsk.*

Suez Bay. Recorded also by Zanardini from the same locality.

16. Sargassum subrepandum, *J. Ag.*

Suez Bay. Trinkitat.

17. Cystoseira myrica, *J. Ag.*

Several fragments referable to this species occurred in the collections. The species is described by Zanardini as "in mari rubro vulgatissima."

18. Hydroclathrus cancellatus, *Bory.*

Dredged from 10–12 fathoms at Khu Sinab. Recorded by Zanardini from Suez, Akaba, and Tor.

19. Padina pavonia, *J. Ag.*

Suakim, Suez Bay, and one young plant from Trinkitat.

20. Zonaria Schimperi, *Kütz.*

Suez Bay. I am a little doubtful of this identification as the plant is a young one, but it agrees with the description given by Zanardini, who records it from the same locality.

21. Dictyota dichotoma, *J. Ag.*
Tella Tella Kebira.

22. Sphacelaria rigida, *Kütz.*
An epiphyte on several *Sargassa.*

23. Ectocarpus siliculosus, *J. Ag.*
Suez Bay, Suakim.

24. Castagnea virescens, *Thur.*
Suez Bay. Suakim.

RHODOPHYCEÆ.

25. Laurencia pinnatifida, *J. Ag.*
Suez Bay. Recorded by Portier from Hodeida.

26. Laurencia divaricata, *J. Ag.*
Suez Bay. Recorded by Zanardini from Suez, and by Hauck from Madagascar and the Somaliland Coast.

27. Laurencia papillosa, *Grev.*
Suakim. Recorded also by Piccone from Massaua and the Assab Archipelago and by Hauck from the Somaliland Coast, and by Zanardini from Suez, Tor, Djedda, &c.

28. Gelidium rigidum, *Grev.*
Trinkikat. Recorded from the Red Sea by Zanardini, from Massaua and the Assab Archipelago by Piccone, and by Hauck from the Zanzibar Coast.

29. Gelidium corneum, *Kütz.*
A form of this species occurs among the collection obtained at Trinkitat, which appears to be near Piccone's var. *ambiguum.*

30. Polyzonia jungermannioides, *J. Ag.*
On *Sargassum dentifolium*, but fragmentary.

31, Hypnæa Valentiæ, *J. Ag.*
Trinkitat and Suez Bay.

32. Spyridia filamentosa, *J. Ag.*
Suez Bay. Recorded also by Zanardini from the same locality, and also from Akaba and Kosseir.

33. CORALLINA TENELLA, *Kütz.*

Suakim. This plant was identified for me by Dr. Reinhold.

34. LITHOPHYLLUM AFFINE, *Fosl.*

Suakim. Dr. Foslie informs me that this species is probably only a variety of *L. Kaiserii*, Heydr., or both may be varieties of the Pacific species *L. pallescens*, Fosl.

35. GONIOLITHON MYRIACERPON, *Fosl.*

Suakim. According to Dr. Foslie this is a variable species, and he identified the plant I sent him with a query.

APPENDIX.

The following two species of Potamogetonaceæ were also present in the collection, viz., *Cymodocea nodosa*, Aschers., and *Halophila stipulacea*, Aschers.; and also *Najas marina*, Linn. (Naiadaceæ), from Suez mud-flats. Fragments of *Salicornia fruticosa*, Linn., were also present in the same gatherings.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—X. HYDROIDA collected by Mr. C. Crossland from October 1904 to May 1905. By LAURA ROSCOE THORNELY. (Communicated by Professor W. A. HERDMAN, F.R.S., P.L.S.)

(PLATE 9.)

[Read 5th November, 1907.]

THERE are 18 species in the collection belonging to 12 genera and 4 families. Of a few of these species there is a considerable quantity, but most are represented by a few colonies only and some by but one, or by a fragment of a colony. They were collected from such places as the floating stage in the Suez docks, the quay-side at Suakim, or from the sides of a floating buoy; they are growing upon seaweeds or upon each other, and some are a good deal overgrown by seaweeds. They range pretty well from north to south of the Sudan coast.

Suborder ATHECATA.

Family Bougainvilliidæ.

Perigonimus vagans, sp. n. (Plate **9**. fig. 1.)

Trophosome.—Colony much branched, about $1\frac{1}{2}$ inches in height. Branches alternate, but inclining all to one side, narrower than the stem and narrowest at the base, where there are a few corrugations. The whole perisarc is coated with sand, giving the colony a yellowish colour.

Polypites, some small on short stalks and with few tentacles, some larger on longer stalks with about 25 tentacles. Both sizes carry gonophores.

Gonosome.—Gonophores borne on short stems, situated on the branches close below the hydranth and containing one medusa each.

Locality.—Khor Shinab, 10–12 fathoms.

Family Eudendriidæ.

Eudendrium ramosum, *Linné*.

Some fragments, probably belonging to this species.

Locality.—Khor Dongola, 3 fathoms.

Family Pennariidæ.

Pennaria symmetrica, *Clark* *.

Numerous colonies, broken at their bases, 5 inches by $1\frac{1}{2}$ inches in size, without gonophores.

Localities.—Shab al Shubuk ; quay-side, Suakim.

Suborder THECAPHORA.

Family Campanulariidæ.

Obelia bifurcata, *Hincks* †. (Plate **9**. fig. 2.)

The height of this species is not given by Hincks, but as it is growing on a small polyzoon, *Nellia oculata,* it cannot be large. The present colonies are under an inch in height. Hincks's species had a simple stem, while these are slightly branched and have the rudiments of a polysiphonic stem, as described by Bale for his *Campanularia spinulosa.* The very long hydrothecæ with about 12 bicuspid denticles, which are not sharp-pointed, borne on short ringed stems, are, however, the same as described for this species by Hincks

* Bull. Mus. Comp. Zool. Harvard, vol. v. no. 10.

† Journ. Linn. Soc., Zool. vol. xxi. 1889, p. 133.

in his original description. The number of rings on the pedicel varies, those higher up on the stem having the shorter pedicels.

The gonothecæ, which are seen here for the first time, undoubtedly belong to an *Obelia*, a fact which therefore fixes the species in this genus. They are not much larger than the large hydrothecæ, and are borne on pedicels with about 5 rings each.

Locality.—Khor Shinab, 10–12 fathoms.

CAMPANULARIA JUNCEA, *Allman* *.

Small overgrown pieces only.

Locality.—Khor Dongola, 20 fathoms.

CAMPANULARIA DENTICULATA, *Clark* †. (Plate 9. fig. 3.)

The present specimens agree with Torrey's ‡ description of this species in height, in branched stem, in the stem opposite the origin of each hydrothecal pedicel taking a knee-like bend, and in the pointed teeth of the hydrotheca. It differs in the pedicel not being always ringed throughout, and in the teeth of the hydrotheca being rather fewer.

The most striking feature of the present species is the mode of branching. The stem rises straight to the base of the hydrothecal pedicel and then takes a bend, after which it rises straight again to the next hydrotheca on the opposite side, and this is repeated sometimes for eight or nine times with the occasional complication of two pedicels being given off at once, nearly opposite to each other or on the same side, one below the other.

Gonothecæ, previously unknown, are to be seen on these specimens. They are situated, usually, near the base of a hydrothecal pedicel, singly, or two opposite, or are, sometimes, given off from the stem. They are borne on short faintly ringed stalks and are very long and cylindrical with blunt tops (see fig. 3).

Locality.—Khor Shinab, 10–12 fathoms.

CAMPANULARIA CHELONIÆ, *Allman* §.

One small specimen.

Locality.—Khor Dongola.

LOVENELLA CORRUGATA, sp. n. (Plate 9. fig. 4.)

Trophosome.—Colony long and straggling and sparsely branched, about 2 inches high. Stem of a pale brown colour, perfectly smooth and unringed,

* Journ. Linn. Soc., Zool. vol. xii. (1874) p. 260.

† Proc. Acad. Nat. Sci. Phil. xxviii. (1876).

‡ "Hydroids of the Pacific Coast," Univ. Cal. Publ. vol. i. (1902).

§ Voy. H.M.S. 'Challenger,' vol. xxiii.

bending to left and right alternately and giving off a hydrotheca at each bend, or sometimes instead of a hydrotheca a long weak-looking tendril, these last are all to be seen on the lower portion of the stem. Hydrothecæ deeply cylindrical, borne on ringed pedicels, resting on an elbow of the stem. Pedicel with 2 to 6 rings, but usually with 4; margin of the hydrotheca with about 10 crenulations meeting the conical operculum at its base. The sides of the hydrotheca slightly fluted on its upper half and corrugated about six times below. Gonothecæ not present.

This species very much resembles figures of *Lovenella clausa*, but the corrugated hydrotheca is a marked difference between the two species.

Locality.—Khor Dongola, 20 fathoms.

CALYCELLA ? sp. (Plate **9**. fig. 5.)

A minute form, without rings to the short pedicel, creeping over a *Perigonimus* colony.

Locality.—Khor Shinab, 10–12 fathoms.

Family SERTULARIIDÆ.

SERTULARIA MINIMA, *D'A. W. Thompson* *.

This species is well represented, covering a seaweed with its interlacing stolons, from which stems, composed of 5 pairs of hydrothecæ at most, rise to the height of $\frac{1}{8}$ of an inch merely. They are unbranched; the whole is coloured like the seaweed, a bright straw-colour.

The pairs of hydrothecæ are united in front and set far forward on the stem and their 2 lateral, marginal teeth, when not concealed by the operculum, are conspicuous. As there are no gonothecæ to help in the identification of the species, this full description becomes necessary.

Locality.—Floating stage, Suez docks.

DIPHASIA MUTULATA (*Busk*) †.

Several unbranched colonies $2\frac{1}{2}$ inches in height, attached to a *Lytocarpus*. The stem and branches in the specimens are jointed. No gonothecæ are present.

Localities.—Floating stage, Suez docks; and Suez Bay, 5 fathoms.

THUIARIA TUBULIFORMIS (*Marktanner-Turneretscher*) ‡.

The present specimens are not more than 1 inch in height and have no

* Ann. & Mag. Nat. Hist. 1879.

† Voyage of the 'Rattlesnake,' 1852.

‡ Hydroiden des k.-k. naturhist. Hofmuseum, 1890.

gonothecæ, but probably belong to this species, as they agree with the description by Nutting *.

Locality.—Suez Bay, 10 fathoms.

SYNTHECIUM MALDIVENSE, *Borradaile* †.

The present specimens are about 6 inches in height, composed of a stem, having hydrothecæ, 3 to an internode, and branches, bearing groups of hydrothecæ in pairs, 2 or 3 pairs to a group. The hydrothecæ have a hooded appearance when the upper valve of the operculum is open, but when closed are seen to have a point on either side. There are no gonothecæ present.

Locality.—Floating stage, Suez docks.

Family PLUMULARIIDÆ.

PLUMULARIA SETACEA, *Ellis*.

A few colonies growing on coral.

Locality.—Khor Dongola.

PLUMULARIA ALTERNATA, *Nutting* ‡.

Present in small quantity only.

Locality.—Coral-reef, Khor Dongola.

PLUMULARIA HALECIOIDES, *Alder* §.

There is a good quantity of this form.

Locality.—Suez dock, floating stage.

LYTOCARPUS PHILIPPINUS (*Kirchenpauer*) ‖.

One colony only is present.

Locality.—Suakim Harbour.

LYTOCARPUS (?) HORNELLI, *Thornely* ¶.

These specimens, which are very fragmentary, are of a much more substantial nature than those collected from off the coast of Ceylon. The branches bearing hydrocladia are polysiphonic at their bases like the stem. What are described in the Ceylon report ¶ as strings of nematophores, alternating with the hydrocladia on the branchlets, are now seen to be complete hydrocladia, as hydrothecæ are also present along with the nematophores.

* 'American Hydroids,' 1904.

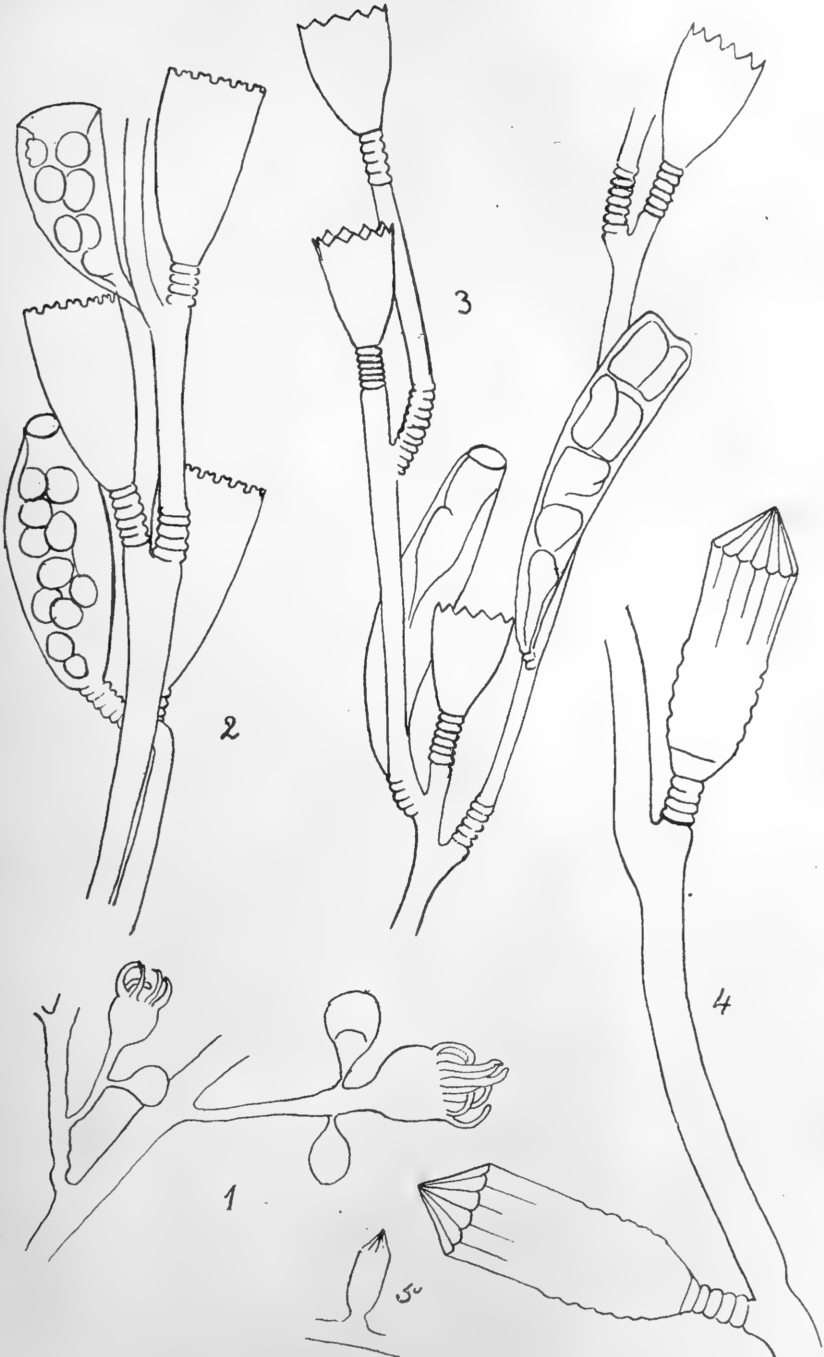
† 'Fauna and Geography of the Maldive and Laccadive Archipelagoes,' vol. ii. pt. 4.

‡ 'American Hydroids,' pt. 1.

§ Ann. & Mag. Nat. Hist. ser. 3, vol. iii. (1859).

‖ Ueber die Hydroiden Familie Plumulariidæ, pt. 1 (1872).

¶ Herdman's Report on Ceylon Pearl Fisheries—Suppl. Rep. viii. p. 123.



L. R. Thornely, del.

HYDROIDA FROM THE SUDANESE RED SEA.

Gonangia are absent from these as from the Ceylon specimens, and so are still unknown.

Locality.—Suez Bay, 5 fathoms.

There appears to be a resemblance between this species and Elof Yäderholm's * *L. gracilicaulis* in the polysiphonic stem, the arrangement of the hydrocladia, and in the form of the hydrothecæ, but his form is unbranched. The absence of gonangia from both makes identification uncertain.

ADDENDUM.—While this paper was passing through the press, Mr. C. Crossland sent from Port Sudan some half-dozen colonies of a new (?) species of *Ceratella*, which are described as follows:—

Family CERATELLIDÆ, Gray.

CERATELLA CROSSLANDI, ? sp. n.

Colony erect; stem deep brown in colour, flattened, much branched, anastomosing here and there and often expanding into spongy extremities, which sometimes adhere to other branches or to foreign bodies, spreading over them in a root-like manner. *Hydrophore* reduced to two wing-like pointed processes, one on either side of the aperture through which the zooid protrudes. *Zooids* situated on all sides of the stems, sparsely or fairly crowded in places and varying in size, the largest having from 30–40 scattered, capitate tentacles. *Gonophores* not seen.

Locality.—Several colonies, the largest measuring 9 inches high by 12 inches wide, growing on shells, and attached to the undersides of vessels at Port Sudan.

This may be a larger form of Hickson's *C. minima* from Zanzibar, but differs in some respects.

L. R. T.

10th October, 1908.

EXPLANATION OF PLATE 9.

Fig. 1. *Perigonimus vagans*, sp. n.
2. *Obelia bifurcata*, Hincks. Showing gonothecæ (previously unknown).
3. *Campanularia denticulata*, Clark. Showing gonothecæ (previously unknown).
4. *Lovenella corrugata*, sp. n.
5. *Calycella* ? sp.

* "Aussereuropäische Hydroiden in Schwedischen Reichsmuseum," Archiv. Zool. i.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—XI. Notes on a Collection of Nudibranchs from the Red Sea. By Sir CHARLES ELIOT, K.C.M.G., Vice-Chancellor of the University of Sheffield. (Communicated by Prof. W. A. HERDMAN, F.R.S., F.L.S.)

[Read 18th June, 1908.]

THE Nudibranchs here described were collected mostly by Mr. C. Crossland, but partly also by Mr. J. G. Logan at Suez and in the neighbourhood of Suakim. The collection, though in many respects typical of the Indo-Pacific area, presents several points of interest. The large flat forms (*Discodoris*, *Platydoris*, etc.), which are generally so abundant on these shores, are poorly represented, probably because their favourite habitat (the underside of large stones on reefs) did not occur in the collecting-grounds. The presence of *Goniodoris castanea* and *Lomanotus vermiformis* (which may be the young of the Mediterranean species *L. genei*) is very remarkable, and the question arises whether they are part of the original fauna of the Red Sea or importations through the Suez Canal. Nudibranchs more than most molluscs have a fondness for adhering to the bottoms of ships and probably make considerable journeys in this way. On the other hand, *Thecacera maculata*, Eliot, which is recorded from Karachi (Eliot, in Journ. of Conchol. 1905, p. 242), is hardly distinguishable from *Th. pennigera*, which is only known from the British Coast, and the distribution of *Lomanotus* and *Goniodoris* may perhaps prove to be similar.

The reappearance of *Ohola pacifica*, *Thorunna furtiva*, and *Plocamopherus ocellatus* is also interesting. These curious forms have hitherto been known only by the descriptions of scanty alcoholic material or by the brief account of Leuckart (1828).

I have registered seven new species with considerable hesitation. It is possible that none of them are really new forms, but the characters of the specimens as preserved do not agree with those formulated for any recognized species. *Lomanotus vermiformis* and *Pleuroleura glabra* are perhaps immature. *Artachæa verrucosa* and *Peronodoris denticulata* are very like Bergh's *A. rubida* and *Peronodoris cancellata*, but differ in their dentition. *Kentrodoris labialis* is perhaps identical with Pease's *Doris setosa*, but is certainly different from the species of *Kentrodoris* described by Bergh, and does not entirely agree with the characters of the genus as formulated by him, since it has a labial armature. But it agrees even less with the characters of the only alternative genus, *Audura*, a form with a labial armature which offers some resemblance to *Kentrodoris*. It therefore seems necessary either to create a new genus for its reception, or to refer it to *Kentrodoris*. I have

adopted the latter course. Species possessing a labial armature are found in genera which are defined as being without this feature (e. g., *Platydoris* and *Staurodoris*) ; and though strong plates or real jaws are an important character, the difference between a labial cuticle with a vestigial armature and one which is totally unarmed is very small and does not necessarily entail other structural differences.

Very curious are the specimens of *Doridopsis rubra*, in which, as testified by the notes on the living animals as well as by the condition of the preserved specimens, the pockets of the rhinophores and branchiæ have almost disappeared, causing those appendages to become practically non-retractile.

The list of species is as follows :—

1. Pleuroleura glabra, sp. nov.
2. Lomanotus vermiformis, sp. nov.
3. Crosslandia fusca, Eliot.
4. Melibe bucephala, Bergh.
5. Æolidiella orientalis, Bergh.
6. Elysia grandifolia, Kelaart.
7. Hexabranchus sanguineus (Rüppell & Leuckart).
8. Nembrotha limaciformis, sp. nov.
9. Trevelyana striata, sp. nov.
10. Ohola pacifica, Bergh.
11. Plocamopherus ocellatus, Leuckart.
12. Goniodoris castanea, Alder & Hancock.
13. Chromodoris diardii (Kelaart).
14. Chr. quadricolor, Rüppell.
15. Chr. maculosa, Pease.
16. Chr. pallida (Rüppell & Leuckart).
17. Chr. inornata, Pease.
18. Thorunna furtiva, Bergh.
19. Platydoris incerta (?), juv., Eliot.
20. Discodoris amboinensis (?), juv., Bergh.
21. Kentrodoris labialis, sp. nov.
22. Peronodoris denticulata, sp. nov.
23. Asteronotus hemprichi, Ehrenberg.
24. Artachæa clavata, Eliot.
25. Artachæa verrucosa, sp. nov.
26. Doridopsis rubra (Kelaart).
27. Doridopsis nigra (Stimpson).
28. Doridopsis sp.
29. Phyllidia varicosa, Lamarck.
30. Marionia cyanobranchiata (Rüppell & Leuckart).

PLEUROLEURA GLABRA, sp. nov.

? = *Pl. ornata*, juv. (For the genus see Eliot: "Nudibranchs of Southern India and Ceylon," Proc. Zool. Soc. 1906, p. 676, ff.)

The only notes are: "Khor Dongola; nudibranch; no gills. White with grey mottlings. Eyes halfway up rhinophores."

The preserved specimen is 10 mm. long and 4·3 broad. Its back is mottled with various shades, both light and dark, of grey and greyish green. A row of small black spots runs along the line of junction between the mantle-margin and the sides of the body, and there are others on the sides of the foot.

The general shape is as usual in the genus, but the back is quite smooth and bears no ridges or tubercles. The rhinophores are entirely retracted into distinct holes about 1 mm. apart. The dorsal surface passes through them into the frontal shield without interruption. There is a row of pores (apparently cnidopores) on the mantle-edge; most of them are set in white spots.

The jaws are yellow and the edge bears several rows of longish denticles, which are more than a mere mosaic and become more numerous on the lower part of the jaws. The formula of the radula for the longest rows is $28 \times 18 + 5 + 1 + \mathrm{I} + 1 + 5 + 18$. The central tooth has a long cusp and about 11 distinct denticles on either side. The first lateral looks rather like half the central tooth and bears 7 distinct denticles on the outer side. The next five teeth gradually assume the ordinary hamate shape, and like the first lateral bear 7 denticles on the outer side. The remaining teeth vary from 16 to 18 in number, and in the majority of rows are only 16. They are hamate and quite smooth, no denticles being found beyond the sixth tooth from the rhachis. The outermost teeth are smaller and slenderer than the rest.

In order to preserve the single specimen the other organs were not examined.

Ten species of *Pleuroleura* have been described, but the present specimen does not seem to belong to any of them. It is possible that it may be a young specimen of *Pl. ornata*, which has a tuberculate back, a broader radula, and more numerous denticles on the central tooth. Provisionally I describe it as a new species, the principal characters being the dentition and the smoothness of the dorsal surface.

LOMANOTUS VERMIFORMIS, sp. nov.

(See for the genus, Eliot: "Notes on some British Nudibranchs," Journ. Marine Biol. Assoc. vii. 1906, p. 348, ff.)

The notes on the living animal are as follows:—"Engineer Island, Khor Dongola. A diver brought a large plumularian hydroid from among coral

on the reef from which I took many specimens of a small Tritonid. They are elongated with a tapering tail, the body being almost vermiform and does not contract on killing. The cerata are remarkably small. The colour black with specks of white which are especially aggregated in two bands along the sides of the back. Cerata translucent with white tips."

Forty-five specimens are preserved. The largest are 8–10 mm. long, with a maximum breadth of 1·5 mm. The colour remains much as described. The cerata are 20 or more on either side, not foliaceous but concave spoon-shaped laminæ. The oral veil bears two longish processes, and the rhinophore sheaths from two to four. The rhinophores are brown or spotted with brown; they appear to bear a few very inconspicuous perforations below the club. The anterior margin of the foot presents various shapes and is probably alterable in life, but is not produced in conspicuous prolongations in any specimen.

The jaws are as in *L. genei*, with many rows of denticles or projections which have the appearance of a mosaic near the edges. The radula is in the confused state common in the genus. There are about 17 rows, and where the rows can be clearly counted the formula is 9 . 0 . 9. The teeth are irregularly denticulate on both sides, much as in *L. marmoratus*.

The liver appears to consist of three divisions and to enter the stomach by three ducts, one posterior and one on either side. The posterior liver is the largest; it encloses the hinder part of the stomach and extends some way backwards. The anterior livers run forward as far as the sides of the buccal mass. Though branches of the livers extend to the bases of the cerata, they do not send prolongations into them, or into the rhinophore sheaths. Both the cerata and sheaths contain blood-spaces but not hepatic diverticula. The genitalia appear to be mature. The verge is white, large and without any armature. The hermaphrodite gland is large and appears to contain ripe ova; it lies mainly under the posterior liver, but rises towards the dorsal surface at its sides. The mucus-gland is very large.

This species comes very near to *L. marmoratus* in size, colour, and anatomy, but differs in the following points:—(1) The shape is much more elongated and vermiform; (2) the cerata do not form a wavy curtain but a series of separate and equal projections, all on the same level, and though all are set on the prominent dorsal margin they are not connected by a membrane *; (3) the corners of the foot are not developed into distinct prolongations. If these features were found in only one specimen their specific value would be doubtful, but as they occur uniformly in a large number they have some weight, particularly as it is a considerable assumption to suppose that *L. marmoratus* is found in the Red Sea.

* It is of course difficult to be sure of this point in such small animals, for the membrane would be likely to shrivel up when preserved.

If this form is not a new species it is possible that it may be the young of *L. genei* or a variety of *L. marmoratus*, which itself may be the young of *L. genei.* If it is identical with any Mediterranean species, it would be interesting to know whether it is a natural denizen of the Red Sea or whether it has made its way through the Suez Canal. *Lomanotus* has not hitherto been recorded from the Indo-Pacific area.

L. vermiformis appears to be sexually mature, but it does not follow from this that it has attained its full size and final shape, for nudibranchs continue to grow after their sexual organs are functional.

Crosslandia fusca, *Eliot.*

(Eliot: "On Nudibranchs from Zanzibar.—I.," Proc. Zool. Soc. 1902, pp. 64–68.)

Twelve specimens of various sizes and colours. The following notes, made by Mr. Crossland on the living animals, refer to the four largest, but he seems to imply that some of the smaller specimens were green.

"Four brown specimens from buoys at Nur el Shekh, Khor Dongonab, Red Sea, 10.12.07. Three found together on one buoy, one on the other. Length when fully extended is 38 mm.

"Colour varies as follows :—

"First specimen (like one taken here in May 1907) clear translucent fucoid brown with darker dots and a darker line edging dorsal crest and cerata. A few specks of opaque white laterally ; two are conspicuous and bear conspicuous papillæ in the centre. A white line is present inside the dark edging of the crests.

"Second specimen ditto, but more white, in form of patches of opaque pigment put on so thinly as to be translucent.

"The third and fourth specimens are of a distinctly darker brown, with the addition not only of whitish but of purplish pigment, exactly the tint of the patches of encrusting nullipore and foraminifera generally present on weeds. This colour is remarkably strongly developed in the fourth individual. The bright blue circular spots noted at Zanzibar are here present also. In the third specimen they are easily visible to the naked eye, in the others only under a lens ($\times$ 10). In no. 2 they are rather dull and ill-defined.

"The series from green onwards is complete, showing all the range of protective colour devices characteristic of habitat among Zostera, Fucus, or darker weeds. It is to be noted that the colour scheme does actually correspond with the habitat; though there is little or no brown fucoid weed on these buoys, the growths present are of dark colours. Compare the exactly similar series of colours found in various species of Tectibranchs, where one species contains individuals of bright green, green with nullipore purple patches, fucoid brown and ditto with purple. In some of these cases the protective adaptation includes also the form of the animal (flattened) : here

the form is adapted by being drawn out into crests and frills, the edge of which is cut into crinkles and points, like the leaves of the common fucus here."

Mr. Crossland is no doubt right in regarding all twelve specimens as belonging to the same species, but in their preserved condition they exhibit considerable variety not only of colour but of form, due probably not to distortion but to different stages of growth.

A. Five of them are relatively large, being 18–22 mm. long and 10–15 mm. high.

(1) One is pure white with yellow branchiæ, which are found only inside the wings and on the caudal crest. The wings are rounded.

(2) As no. 1, but with yellowish-brown margins and spots. The margin of the wings is crinkled. Two specimens.

(3) In two other specimens there is more green tint. There are chocolate markings and also a few brownish ocelli. In these specimens the branchiæ are found outside as well as inside the wings. The body is hard and stoutly built; the wings thickish and with strongly crinkled margins.

B. Seven smaller specimens, 6–14 mm. long and 4–8 mm. high. They are all whitish, but with a very variable number of bright brown spots. As a rule the branchiæ are found only inside the wings. In one specimen they also occur outside. In all the wings bear on their edges more or less developed digitate processes. In one specimen they are very distinct and symmetrical, five in number on each wing. In the others they are more irregular. There are also digitate processes on the mantle-edge, especially between the wings and rhinophores.

All the specimens have the following characters in common:—

(*a*) There is a moderate but not large caudal crest, more marked and more jagged in the smaller specimens.

(*b*) There is a row of papillæ (2–4 can be seen clearly in different specimens) on either side of the body, halfway down.

(*c*) The wing on either side of the body never consists of two outgrowths or papillæ rising from separate bases with an interval between them as in *Scyllæa pelagica*, but always of a single common portion more or less notched or divided at the top. In the smaller specimens this common portion is about half the size of the whole expansion, and the outer part is more or less distinctly bifid and bears digitate processes. As the animal increases in size, the common portion grows at the expense of the processes, and the whole expansion ultimately assumes the form of an undivided fold with somewhat crinkled edges, much as in Mr Crossland's figure of *Crosslandia viridis*, l. c.

The intestines are whitish, the liver greyish white. The spermatotheca is covered with fine brown dots.

The jaws are brownish near the edge, with three or four longitudinal stripes of darker brown. The rest of the surface is whitish. They are covered with a tessellated pattern which under a high power is seen to consist of small projecting scales with roughly semicircular and indented edges. The scales do not overlap but stand each at a little distance from the others.

The formula of the radula is about $20 \times 25 . 1 . 25$. In the previous description by Mr. Crossland and myself, we stated that the teeth in the middle part of the half rows are denticulate only on the external side, but though this is the appearance which they present *in situ* they are in reality all denticulate on both sides. It is extremely difficult to see the shape of the whole tooth from one point of view. They generally present the appearance of bearing 3 lateral denticles only, but in reality 5–9 were found to be present on all the teeth which I examined in detail. The hooks of the teeth are fairly strong and erect.

The œsophagus passes into a long unarmed stomach with thin walls, and that into a second stomach armed with a circle of 16 plates, yellowish, triangular and alternating in size. The whole alimentary canal is a tube of unusually uniform breadth, not presenting marked pouches or constrictions.

The two divisions of the liver adhere to the outer wall of the stomach and no long connecting ducts are visible, nor could I find any hepatic diverticula extending into the cerata. The liver can be removed without difficulty from the body-cavity and does not adhere to its walls.

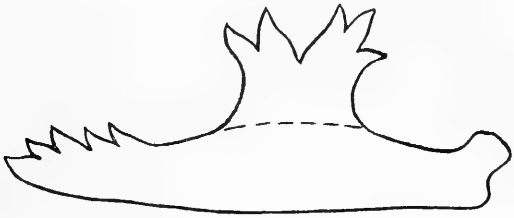
The hermaphrodite gland forms three large white spherical masses.

Mr. Crossland also describes and gives a rough figure of the spawn. It is deposited in a single coil, which he says resembles a string of beads, each bead containing from twenty to fifty eggs. The colour of the coil is light yellow-brown, and there are four gelatinous envelopes—(1) the attachment jelly; (2) and (3) coverings of the egg-strings; (4) a covering round each separate egg. It would appear from his figure that the egg-strings are twisted within the string of jelly, independently of the coiled shape of this latter.

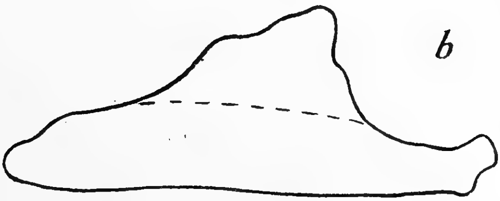
These specimens seem referable to the forms previously described as *Crosslandia viridis* and *fusca*, the two being, as was surmised, varieties and not separate species. It is preferable to keep *fusca* as the specific name rather than *viridis*, firstly, because the larger of the specimens belong to that variety, and secondly, because in the event of the genus *Crosslandia* being united with *Scyllæa* the name *Sc. viridis* is preoccupied by one of Alder and Hancock's species.

Provisionally I keep the genera distinct though now thinking the difference between them of doubtful generic value, since the young *Crosslandia* has

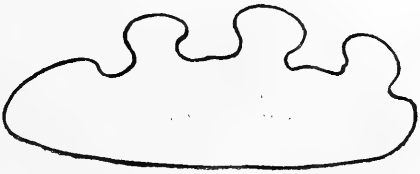
much more the appearance of *Scyllæa* than the adult animal. The chief differences are :—(1) In *Crosslandia* the liver is only slightly, if at all, ramified. In the present specimen no branches at all were found, but it is probable that individuals (as in *Dendronotus* and *Bornella*) show considerable variation in this respect. In *Scyllæa* the liver is considerably ramified, though it does not penetrate the rhinophores and papillæ to the same extent in all species.



a



b



c

(2) In *Scyllæa* there are on either side two dorsal processes quite distinct from one another. In *Crosslandia* the two are joined. The dorsal outgrowth thus formed is deeply bilobed in the young animals ; in the adults the bilobation more or less completely disappears and a single wing-like expansion is the result. I cannot find in any description or figure * of the species of *Scyllæa* a record of such a formation, nor have I come across it in examining a great number of specimens labelled *Scyllæa pelagica* and coming from both the Atlantic and Indo-Pacific Oceans. It must therefore, I think, be regarded as a distinct character of at least specific importance. The

* Possibly the figure of *Scyllæa Hookeri* (no. 203 in Mrs. Gray's 'Figures of Molluscous Animals') may be the young of this form. But nothing seems to be known of the name except this not very distinct figure.

accompanying series of figures shows the outlines copied from actual specimens of (*a*) a young *Crosslandia*; (*b*) an adult *Crosslandia*; (*c*) a *Scyllæa pelagica* from the Indian Ocean.

It is interesting to observe that the caudal crest and the digitations of the wings disappear as the animals grow older. Something similar seems to occur in *Lemanotus Eisigi* as described by Trinchese. He states that the young animals have almost the appearance of Æolids with separate dorsal papillæ, but as they grow up these become united at the base, so that in the adult the back is bordered by a membranous expansion bearing points.

MELIBE BUCEPHALA, *Bergh.*

(Bergh: "Danish Expedition to Siam," Gasteropoda Opisthobranchiata, 1902, p. 205, ff.)

Two specimens. The notes say they were found washed up on the sand between Suez and Port Tewfik. They were transparent and colourless, except for a light tinge of brown and a plentiful sprinkling of opaque white dots. They also bore numerous raised spots, which were white or brown on the body but often colourless on the cerata.

The larger specimen is about 90 mm. long including the hood. The body bears no woolly or filamentous processes, but is covered with soft tubercles which are often compound. On the back between the cerata these tubercles become elongated and bear five or more short branches, but they are not foliaceous and can hardly be termed branchiæ. The cerata have mostly become detached, but there were apparently five pairs and an unpaired one on the tail (absent in the second specimen). Their shape is very various, and shows that in dealing with preserved specimens this character must be used with caution as a specific distinction. It would seem that the cerata in their natural condition have a fairly long stalk which is constricted at the base, but in the upper part becomes gradually wider and thinner until it terminates in a membranous expansion which is notched in the middle (more distinctly in one specimen than in the other). The whole surface of the cerata is covered with knobs which become smaller towards the top, where they are replaced (especially on the inside of the cerata) by short thin papillæ.

The hood is large and its outer surface much like the rest of the body. The margin, which bears three or four rows of simple cirrhi 2–3 mm. long, is not even but deeply incised below the mouth and in the corresponding point on the other side. Both specimens show this peculiarity, and the line of the cirrhi is continued in the notches, though they are less numerous there. The rhinophore sheaths are small with a membranous expansion behind, tuberculate and with crenulate margins. The rhinophores themselves are yellow with only a few perfoliations.

At the bottom of the hood is a round fleshy lip, covered with minute papillæ which are tipped with opaque white. Below it are two small

yellowish jaws, about 4 mm. long. They are faintly striated and under a high power are seen to bear on the edge low, wavy prominences which can hardly be called denticles. From the mouth a tube with laminated walls leads into a small yellow stomach, which is armed with 19 or 20 plates and prolonged posteriorly into a dark-coloured tube. The plates are rather bright yellow in colour, hog-backed in shape, and alternately large and small. The larger are about 3·5 long and ·5 mm. high; the smaller half the size. The liver is a flocculent and rather diffuse collection of brown tubes, spread over and between the globules of the hermaphrodite gland and lying behind the stomach. Two accessory portions of the liver open into the stomach right and left. The branches of the liver which go to the cerata are more compact than the main mass. Up to the bases of the cerata they are of a considerable size (about 3·5 mm. broad), but after entering the appendages they contract and become much narrower. They extend about two-thirds of the way up the cerata and divide into two or three branches.

The hermaphrodite gland consists of a number of spherical globules which occupy a considerable portion of the body-cavity. There is a large, soft, round prostate, from which issues a strong and muscular vas deferens. The penis is large and distinctly hooked in both specimens. The fan-shaped organ described by Bergh in some species was not found, but near the end of the female branch is a large sac-like organ which is exserted in one specimen so that the orifice lies at the bottom of it.

This appears to be the *M. bucephala* of Bergh. The shape of the hood is the same in both specimens, and does not look as if it were due to distortion or mutilation.

Although the generic characters of *Melibe* are remarkable and easily recognizable, the specific distinctions within the genus are very indefinite and few of the species can be regarded as certain. It is probable that they all have jaws, though the contrary has been asserted and I was unable to find any in a specimen of *M. pilosa* which I examined in Japan both while it was alive and directly after death. The jaws usually lie immediately below the lips, and the difficulty of finding them is probably due to the fact that in death the buccal parts may be abnormally protruded or retracted so that the jaws become situated in an unexpected place.

Æolidiella orientalis, *Bergh.*

(Bergh: Mal. Untersuch. in Semper's Reisen, Heft xvii. p. 875; *id.*, Beiträge zur Kenntniss der Aeolidiaden, IX., in Verhand. der k.-k. zool.-botan. Gesellschaft in Wien, 1888, p. 673.)

Five specimens said to have been found "in the washings of coral &c. from a buoy in Suez Bay." The notes on the living animals are as follows:—

"Small, white with orange-red markings. Short and stumpy in form.

Rhinophores and cerata short and simple. Rhinophores not perfoliate ; eyes just behind them, conspicuous. Foot broad, especially in front, but no pedal tentacles. Oral tentacles fairly long.

"Body translucent, but ends of rhinophores whitish and the greater part of their length orange-red. A **V**-shaped (inverted) mark behind them of the same colour, and two broad marks running forward from the base of the rhinophores. There are faint sprinklings of the same pigment over cerata and body. There are on the back whitish marks as shown in the sketch, and a very faint brown tinge (due to the liver) in the bases of the cerata."

A rough sketch shows a **Λ** between the eyes, and behind them a pattern having somewhat the shape of a Greek vase without handles extending down the centre of the back.

The largest of the preserved specimens is 9 mm. long and 2·5 mm. broad. The others are rather smaller. The cerata are not arranged in any visible groups, but are set three or four deep all along the sides of the body, as far as the tip of the tail. On either side there are about 30 cerata of moderate size, and outside, in the outermost line, ten or twelve minute ones. The cerata are fusiform in shape but occasionally dilated at the tips.

The jaws are yellow ; the edge is undulated but no denticles were seen. The radula consists of only twelve teeth. The shape of the smaller teeth is much as in Bergh's plates (*l. c.*), but in the larger ones the central part is much more developed and more conspicuous, so that the whole looks like a shield with two pectinate wings. The median denticle is fairly strong with a minute denticle on either side. The wings bear from 14 to 20 denticles. No armature was found on the genitalia.

In spite of some slight differences of coloration this seems to be Bergh's *Æolidiella orientalis*, which is distinguished from the other species by having the anterior margin of the foot rounded and not produced into pedal tentacles. In Bergh's specimen the lateral denticles of the teeth were more numerous and the radula longer, but the animal was also considerably larger (23 mm., whereas these specimens are only 9 mm.). As the radula grows the teeth become more numerous, and it is clear from the present specimens that the later teeth grow broader and bear more denticles.

ELYSIA GRANDIFOLIA, *Kelaart.*

(Kelaart: Ann. & Mag. Nat. Hist. 1859 (3), iii. p. 493; Eliot: "Nudib. of S. India & Ceylon," Proc. Zool. Soc. 1906, p. 689.)

The notes on the living animal are as follows :—"Under stones, reef-edge N.E. boundary of Shabul Shubuk. Rather a dull green, mottled with darker spots. Edges of lateral expansions with a thin clear black line, within which is a rather broader yellow line. Rhinophores edged in the same way but neck is green all over. *The lateral expansions are much*

crinkled when crawling and are carried upright. Large specimen 3 cm. long, small 1·7."

Three specimens are preserved. They are whitish, with a plain grey border to the wings and rhinophores, and a few grey spots scattered over the upper and under surface, and in one specimen especially numerous on the pericardium. In some specimens there are also traces of yellow coloration.

The largest specimen, which is leaf-like and somewhat crumpled, is about 27 mm. long and 22 mm. broad. Could it be spread out flat, the dimensions would be rather greater. The anterior genital mass is blackish and is visible through the skin, as are also the follicles of the hermaphrodite gland which extend almost to the edges of the wings and give the dorsal surface a mottled appearance. The veins on the back are very prominent and distinct. The pericardium is considerably prolonged in two specimens, as in Kelaart's figure. In the third this prolongation is less noticeable and the organ is constricted in the middle so that its shape is that of an hour-glass.

The radula in the specimen dissected consists of 5 teeth in the ascending portion, 18 in the descending, and about 15 in the heap. The teeth are of the usual shape. The tip is not very pointed and the anterior part of the lower edge is minutely serrulated. This serrulation is visible only under the highest powers and then with difficulty, but still it can be detected on all the teeth, even the small ones.

It is doubtful if many of the described species of *Elysia* will ultimately prove valid. Kelaart's names (*grandifolia*, *punctata*, and *cærulea*) have priority. The last of these (= *E. lineolata*, Bergh) is clearly distinguished by its brilliant coloration. In the others the coloration (especially the borders and spots) is very variable, and there are few other definite specific characters. The teeth of *E. grandifolia* are serrulate and those of other species smooth, but since the serrulation is only visible under the highest powers its absence cannot be assumed unless a very thorough search has been made.

Hexabranchus.

The animals of this genus are very variable in shape and colour, and few of the described species can be regarded as certain and well characterized. The species or variety noticed below is undoubtedly the *H. prætextus* of Ehrenberg (1831), but there can be equally little doubt that it is also the *Doris sanguinea* of Rüppell & Leuckart (1828), and this specific name must therefore have priority.

The *H. punctatus* recently described by Bergh ('Siboga' Expedition, 1905, p. 92) is, I think, the same as the animal described by me under the name of *H. adamsii* (?) in the Proceedings of the Malacological Society, 1905, p. 235. The species is probably the animal figured by Adams, though as we have

practically no information except the figure, the identification must be somewhat doubtful. Whatever the animal is called it appears to be a distinct species, as Bergh says, and more definitely characterized than most.

HEXABRANCHUS SANGUINEUS (*Rüppell & Leuckart*).

(*Doris sanguinea*, Rüppell & Leuckart in Neue Wirbellose Thiere des Rothen Meeres, 1828, p. 28 = *Hexabranchus prætextus*, Ehrenberg: Symbolæ Physicæ, 1831. *Cf.* Hägg: "Two new Opisthobranchs from the Red Sea," in Results of Swedish Zool. Exped. to Egypt and White Nile, 1901, p. 5.)

The notes on the living animal say: "Hexabranchus; seen on the reef south side of Tella Tella Saghir at a depth of one fathom and obtained by diver. Colour as in the East African variety in which there is no yellow. The whole body is pure crimson except the mantle-edge which has the usual streak of white."

This is the *Hexabranchus prætextus* of Ehrenberg, the type of which was captured at Tor in the Red Sea. The species has been described under many other names, and in particular *H. anaiteus*, Bergh, *H. Petersii*, Bergh, *H. suezensis*, Abraham, and *H. plicatus*, Hägg, are probably referable to it. Hägg in defining the characters of his *H. plicatus*, forgets that these animals can alter their shape and proportions even in life, and the fact that one alcoholic specimen is circular and another elliptical is not necessarily of any specific importance.

H. sanguineus seems to be characteristic of the Red Sea but less common elsewhere. On the coast of East Africa I found it much more rarely than the mottled varieties.

NEMBROTHA LIMACIFORMIS, sp. nov.

Two specimens described by Mr. Crossland separately, but apparently referable to the same species. The notes on the living animals are as follows:—

(1) "Polycerid, on a piece of coral obtained by a diver from 1 fathom on a reef in the S.E. part of Shab ul Shubuk. Strikingly long and narrow, measuring 20 mm. × 4 mm. when crawling. The head is rounded and about one millimetre wider. The foot is a mere groove. The body tapers to the sharply pointed tail, but is rounded in cross-section and has no processes whatever. Gills short and thick, irregular in arrangement, so that it is not easy to say whether there are 3 or 4. They are very contractile but there is no gill-pocket. Rhinophores perfoliate, very long and carried vertically; they have no proper pockets. Colour blood-red, with sparsely scattered small yellow dots and a few yellow blotches. Gills bright light yellow

tipped with violet, and the rhinophores which are blood-red like the body are also violet-tipped."

(2) No locality is given. "Polycerid. Limaciform with pointed tail. Rhinophore cups with low raised rims. Colour red-brown with bright light yellow opaque dots and three marks of the same : one pear-shaped in the middle part of the front of the mantle, and the others, more elongated, behind the rhinophores. Rhinophores brown like the body but with a large clear violet spot at the tip of each. Gills light yellow, tipped with violet ; three in number ; irregularly bipinnate."

The preserved specimens are much distorted and contracted into an almost spherical shape. No external appendages are visible except the gills, which are as described by Mr. Crossland. The rhinophores are completely retracted, in spite of Mr. Crossland's remark that in the living animal there were "no proper pockets."

The integuments contain spicules, granulate and rather irregular in shape, slightly swollen at both ends but not branched.

In the central nervous system three pairs of ganglia are visible, the division between the cerebral and pleural portions being distinctly marked. No trace of a labial armature was found. The radula consists of ten rows in one specimen and eleven in the other with a formula of 7.1.1.1.7. Though the rhachis is almost entirely hidden by the large laterals which close over it, it is wide and bears in the middle a row of squarish plates, somewhat thin and indistinct. Their anterior margin is reflexed and bifid or indistinctly jagged. In some cases the right side is slightly higher than the left. At the side of these teeth are slightly raised areas of irregular shape which are perhaps merely folds of skin, but might be regarded as indistinct accessory teeth. The laterals are large, yellowish, and of the type usual in the genus. They have a strong and rather rectangular terminal hook and also a strong wing or spur, and project into the rhachis across the median teeth. Beyond them are seven marginal teeth, low and colourless. The first retains something of the hamate shape ; the rest are mere plates. The seventh is sometimes absent and in a few rows there are only 5. The genitalia were too hardened for examination.

The combination of shape, colour, and denticulation found in these specimens does not harmonize with any of the described species of *Nembrotha*. It is possible that the animal is a lighter coloured variety of *N. rubro-ocellata*, Bergh ('Siboga'-Expeditie, p. 201), which is only imperfectly known, the radula having been lost. It seems best to create a new species characterized by (1) its elongated, limaciform shape ; (2) its coloration, red, yellow, and violet ; (3) its dentition. *Angasiella edwardsii*, Crosse (Journ. de Conchyl. 1864, 3me série, tom. iv. no. i) is possibly a Nembrotha of similar shape, but is said to be covered with small spines.

TREVELYANA STRIATA, sp. nov.

The notes on the living animal are as follows :—

"From shallow water: bottom mud and weed. 3·7 cm. long, white with thick definite bands of bright dark yellow. One forms a border to the mantle and foot, others, which are broken, extend down the back and sides of the body. All are raised more or less. Gills as in *Trevelyana*, pinnæ more or less parallel with the rhachis. In this species the gills are arranged in a transverse row across the body and project on either side. The middle three in front of the anus are reduced: the whole are placed at about the middle of the length of the body. The rhinophores and rhachis of gills are also yellow. Tail short and blunt; the median yellow line upon it is much raised into a crest. The animal is very soft and contractile."

As preserved it is much contracted and the external features are distorted; but as Mr. Crossland labelled it *Trevelyana* it probably had the usual shape of that genus when alive. The ridges are still plain and the following can be distinguished :—(*a*) a medio-dorsal ridge, well-developed behind the branchiæ but imperfect in front of them; (*b*) a ridge on either side of this, well-developed before the branchiæ but imperfect behind them; (*c*) a ridge running completely round the body and forming, as far as can be judged, both a mantle-border and a frontal veil; (*d*) two ridges on the sides of the body. All these ridges are very distinct and about one millimetre high.

The anterior part of the body is much retracted, and the rhinophore openings cannot be seen. The branchiæ form a straight transverse line in a cleft. In the middle are three small ones in front of the others. Those at the sides are larger and pectinate, but it is difficult to count the number as smaller plumes are mixed with the large ones, and might be variously considered as separate or annexes. There are about 6 large plumes on either side of the centre.

The blood-gland is thick and purplish grey. The central nervous system consists of three very distinct pairs of ganglia, the cerebral and pleural ganglia being clearly distinguished. The salivary glands consist of two short, thick, white bands. No trace of an armature was found on the labial cuticle. The radula is fragile and torn into two pieces. The formula is apparently about $14 \times 18 . 0 . 18$; but perhaps there are as many as 22 teeth in some rows. The teeth are awl-shaped and all much the same; but those which appear to be the innermost (though their position is not quite certain) are taller and straighter than the rest and have smaller bases.

The hermaphrodite gland is represented by a single irregularly shaped mass, which is deeply furrowed but not divided into separate globules. The spermatotheca is small and round: the spermatocyst of about the same size and pear-shaped. The penis and the lower portion of the small vas deferens are armed with minute transparent spines. A reticulate gland, resembling the

prostate of *Euplocamus* but smaller, envelops the vas deferens, the spermatocyst, and the spermatotheca.

This animal does not coincide with any of the recorded species of *Trevelyana*. Externally it is characterized by the very distinct and prominent ridges; in the internal genitalia, the hermaphrodite gland and the prostate offer peculiarities.

OHOLA PACIFICA, *Bergh*.

(Bergh: 'Challenger' Expedition, Zool. x. Nudibranchiata, p. 52, 1884.)

The notes on the living animal say: "Polycerid from Mersa Makdah, 7 fathoms. Of an extremely soft gelatinous consistency and bright orange colour except for certain marks of black and dark blue, *e.g.*, the edges of the rhinophore cups are black, the rhinophores themselves blue: the gills have each a black line on the back of the rhachis; there are marks on the processes behind the gills, on the tip of the tail and at the angles of the velum."

The preserved specimen is 17 mm. long, 6 mm. broad, and 7·5 mm. high without counting the gills. The free part of the tail is 4 mm. long. The animal is stoutly built, and the colour, which has now become grey and black, is distributed as described above. The head parts are contracted and distorted, so that the structure of the rhinophore sheaths is not very plain. It would appear that the openings are partly surrounded by a fold of skin, and protected on the outside by a large process about 2 mm. long. The rhinophores are small, dark, deeply retracted, and bear a few perfoliations. The branchiæ are four or five. In front of the anal papilla is a very large and strong plume, with an accessory plume on the left. The lateral plumes on either hand are also strong and distinct but not so tall. Behind the anal papilla are some small low branchial tufts which are not combined into a plume. Behind the branchiæ are two large processes 4 mm. long, and on the tail what looks like the remains of a jagged crest.

The central nervous system, as seen from above, shows four very distinct divisions arranged in a line on the œsophagus. The pedal ganglia are roundish: the cerebral and pleural ganglia are fused into an elliptical or pear-shaped mass, but the two parts can be distinguished.

The jaws are yellow with processes attached as in *Polycera quadrilineata*. The radula consists of 12 well-formed rows and two more in a shadowy and undeveloped condition. The formula of the rows is $2+2.0.2+2$. There is no central tooth, and the rhachis is broad. The two innermost teeth are hamate much as in *Polycera*, and dark brown. Then come two plate-like teeth, one rather large, the other very small, and both colourless.

The lower part of the vas deferens is thickly armed with spines bent at various angles.

This animal appears to be Bergh's *O. pacifica*, known hitherto only by one specimen from the Arafura Sea. It is easily recognizable by its huge dorsal papillæ which give it a strange appearance, but otherwise it differs only slightly from *Polycera*; it has no processes on the frontal veil, and the radula is narrower.

PLOCAMOPHERUS, *F. S. Leuckart.*

(See for the genus Eliot: "Nudibranchiata from Cape Verde Islands" in Proc. Malac. Soc. 1906, p. 149, and authorities there quoted.)

The type of this remarkable genus is *Pl. ocellatus* described below, of which nothing has been known since specimens coming from the same locality, the Red Sea, were noticed and figured by Rüppell & Leuckart in 1828. It agrees in all essential generic characters with the species which have been subsequently investigated.

PLOCAMOPHERUS OCELLATUS, *Rüppell & Leuckart.*

(Rüppell & Leuckart: 'Neue Wirbellose Thiere des Rothen Meeres,' 1828, p. 17.)

Mr. Crossland's notes on the living animal are as follows:—

"From 5 fathoms Suez Bay, bottom mud.

"In shape recalling the vermilion species from St. Vincent, Cape Verde *, *e.g.*, gills in middle of back and the long tapering tail with a crest. This tail-crest becomes a great fleshy hump proximally. The mantle round its front edge develops a frill of branched processes, and below this are two light-coloured slightly lobed semicircular ridges. The foot is grooved and notched. The general colour is chocolate-brown, but gills and rhinophores, tips of lateral processes, &c., are very dark. Body lighter below and spotted with yellow, very clear (but not light) round spots. These become orange low down on the sides of the body. There are long whitish tentacles laterally with clubbed chocolate ends and small branched side processes.

"Much contracted on killing.

"In Suakim Harbour; several specimens found on the boxes in which live Pearl Oysters were kept."

Five specimens are preserved, one of which is very much larger than the others. It is 23 mm. long, 11 mm. broad across the branchiæ, and 13 mm. high to the tip of the branchiæ. The colour is a rich deep brown with some white mottlings. The ocelli are of a lighter shade, but with dark rims and one or several (2–5) brown dots in the centre. As in the specimens of *Ploc. maderæ* from Cape Verde, the ramose nature of the processes is much clearer in the smaller than in the larger specimens. In the largest specimen of all, hardly any trace of branching remains. About ten processes can be distinguished on the veil over the mouth, but they evidently have a strong

* i. e., *Plocamopherus maderæ.*

tendency to contract and disappear when preserved, and the real number may have been greater. The rhinophore sheaths, the branchiæ, and three pairs of dorsal processes are much as in *Ploc. maderæ*, and there are only indistinct traces of other processes lower down on the sides of the body. The branchiæ form a rather wide bow in front of the anal papilla. The two lateral plumes on either side are connected at the base, with the common result that the number can be counted as either five or three.

The integuments are thin. The buccal mass is fairly large. A rather long and broad tube, laminated internally, runs from it to the liver. The liver-cavity appears to act as the stomach, and no external dilatation was found. The intestine is thin. The liver is of a deep chocolate-brown with a whitish layer of the hermaphrodite gland outside.

The labial armature is a mass of closely packed rods, of somewhat varying shape, which form two greyish-yellow hatchet-shaped plates. The radula consists of 21 rows, with indications that three or four more have been worn off in front. The first 14 rows are of a deep reddish brown, the next four are orange, the next two bright light yellow, and the last white. The formula is 9 (or 10) + 3 . 0 . 3 + 9 (or 10). The rhachis is very wide and folded down the middle so as to form a deep valley, and divided into areas by transverse lines corresponding to the rows of teeth. The three innermost teeth are hamate. The first has a pointed base which projects into the rhachis and looks like another tooth. This first tooth is not much smaller than the others, but the second and third have larger and more spoon-shaped hooks. The nine or ten outer teeth are not hamate: the outer ones are mere plates, and the two or three nearest to the hamate teeth show irregular prominences arising from a plate.

The central nervous system is yellow and markedly granulate. The cerebral and pleural ganglia are distinctly divided.

The lower part of the vas deferens and the glans penis bear very numerous, rather elongate, irregularly arranged spines, and there are some larger scales or prominences in the sheath of the penis. The prostate is whitish and very large. It is of a ramified or reticulate appearance and surrounds the spermatotheca. The large spermatotheca and the spermatocyst are both elongate. The end of the female branch is very thin.

Since the above was written Mr. Crossland has sent me two more specimens of this species from Dongonab Harbour, and says that the animals were in life extremely beautiful. His notes are as follows :—"Largest specimen, when fully extended, 85 mm. long including the extremely acuminate tail, which is about 15 mm. Another specimen 54 mm. long, 8 mm. broad. One specimen has a much darker tint than the other, like half-dry blood. The yellow spots are broad rings, not always round, with dark brown centres and thin brown rings bordering the yellow outside. The lighter specimen has many small flecks of yellow as well as the larger rings, but the dark

specimen has few of the former and more of the latter. Colour of the lighter specimen not uniform, dark and light brown blotches and a good deal of dirty white pigment on the body. In this specimen the dorso-lateral processes are hardly branched at all, and in both only the pair just behind the gills have clubbed ends, which are chocolate in one specimen and light brown in the other. Other details as in former description, except hump on tail which is not so much cut off from the tail-crest."

The length and narrowness of the living animals, according to the above measurements, are remarkable. They can doubtless alter their shape and become less elongate. As preserved, the largest is only about 25 mm. long and continued into an almost globular mass. Neither the frontal veil nor the dorsal processes are conspicuous. The processes appear simple, but when expanded in water each is seen to bear 2–4 small secondary branches, which in their turn bear knobs. The colour of both specimens is purplish with yellowish ocelli. The outline of these ocelli, as well as of their centres, is often irregular and not even approximately circular. In other respects the specimens conform to the previous description.

Mr. Crossland also notes that this species, like many other nudibranchs, suddenly appeared for a short time in great abundance and as suddenly disappeared, after depositing pink spawn, which is not of the same colour as the parent animal and is attached to Polyzoa. The colour of *Plocamopherus ocellatus* varies and appears to depend on its food, which was ascertained to be in some cases a "dark purple-brown branching Polyzoan which is abundant on the underside of our boats." When specimens were kept for 24 hours without food, they became very pale in tint and the colour seemed to pass out of the body in the excrement.

The following further notes on the phosphorescence of the animals are interesting:—

"March 5, 1908.

"The specimens kept in a pie-dish, with frequent changes of water, have been very sluggish all day, generally half-contracted and loosely adherent to the dish. They are not used to the light at any time. At night found them actively crawling loosely extended, and even swimming by bending the body head to tail on either side.

"*When undisturbed* they often emit a fairly bright light which glows steadily for about 5 seconds, goes out, and reappears after an interval of 5–10 seconds. This is emitted from the tip of one of the pair of dorsal processes situated halfway between the head and the gills. (The ends of this pair are rarely club-shaped.) Occasional bright flashes may be given off by the gills.

"This performance may be in abeyance for some time, but all the six specimens regularly lit up, now one, now another, or all together.

"*On touching the surface of the water* or flicking it with one's finger, a

brilliant blue-green flash of light comes from the gills of each specimen. The gill is shown up plainly, and shown to be half-contracted. The light comes from the finer branches, and the larger ones show dark against the light. On flicking the water the light ceases to be shown after the second or third time. If now any part of the body is touched a brilliant series of rapid flashes lasting up to five seconds appears from the gills, the effect being like miniature tropical summer lightning. This also ceases to be shown after the third or fourth irritation. The animal may take to swimming, and then clouds of luminous mucus fill the water with light.

"The strong irritation of a fresh specimen results not only in the main display from the gills, but also a milder yet brilliant and steady light is emitted from the edges of the tail, dorsal crest, and various points and processes of the body."

GONIODORIS CASTANEA, *Alder & Hancock.*

(Alder & Hancock: Monograph. Fam. I. pl. 19, 1846. Bergh: "Die Gattung Goniodoris," Malac. Blätter, Neue Folge 2, 1880, p. 126. For the genus see Eliot: Journ. of Conch. vol. ii. Oct. 1905, p. 243.)

Sent to Mr. Crossland by Mr. J. G. Logan of Suez. No notes except the label "Nudibranch among compound ascidians." Five specimens, of which the largest is 10 mm. long, 5 mm. broad, and 4·3 mm. high. The others are much smaller. All are yellowish brown with markings of darker brown, and in all of them portions of the viscera show conspicuously through the semi-transparent skin as of a deep blue-black. The foot is broad, wider than the body, and the tail bears a well-developed ridge. At the side of the head are large lobes as usual in the genus. The dorsal margin is raised, forming a distinct rim all round the back. Down the middle of the back, from the rhinophores to the branchiæ, runs a ridge. In some but not all of the specimens there are other inconspicuous projections on the back which may be artificial puckers or accessory ridges. The rhinophores are set far forward: they are rather large, non-retractile, and bear about twelve perfoliations. The branchiæ also are non-retractile, seven in number, stout and tripinnate. In some specimens they are tipped with dark pigment.

On opening the body the liver is found to be of a deep dark green colour, covered in parts but not everywhere with the bright light yellow follicles of the hermaphrodite gland, which contrast with it vividly.

In the central nervous system the cerebral and pleural ganglia are closely united, and the pedal separate, so that there seem to be only two pairs of ganglia in all above the œsophagus. The eyes are large and black, set on short stalks. The commissures are short.

No labial armature in the ordinary sense was found, but on the lips are a number of dark ridges and prominences, which perhaps are the structures

described by Bergh, *l. c.* ("Lippenplatte . . . . nur aus höckerartigen Verdickungen der Cuticula bestehend").

The formula of the radula is about $24 \times 1 + 1 . 0 . 1 + 1$, and the teeth are as usual in *G. castanea.* The large tooth has a broad base and a kink in the back. It bears no denticles. The small tooth is hard to see. It is little more than a plate with a mark which may be a jag or a vestigial hook. The ingluvies buccalis is small with a very short thick stalk.

The vas deferens is armed with spines set on flat plate-like bases.

This form does not appear to be identifiable with any of the known tropical species of *Goniodoris.* It cannot be *G. modesta,* which has a long thin tail, or *G. citrina,* which has a lobed mantle margin and denticulate teeth. *G. aspersa,* which is more like it, is said to have rudimentary jaws, like *Acanthodoris pilosa,* and also a smooth back and a reflexed mantle-margin. On the other hand, the present specimens agree in most points with the descriptions of *G. castanea,* though the labial armature is perhaps even less definite than as described by Bergh. The distribution of this species is very remarkable. It is recorded from the N. Atlantic, the Mediterranean, and New Zealand (Bergh, in Semper's Reisen, vi. ii. p. 89), where it was found on the keel of a ship which had been sixteen months in Otago Harbour. It may be wondered whether its presence at Suez is due to natural distribution or to artificial importation from the Mediterranean.

Chromodoris diardii (*Kelaart*).

= *Chr. semperi,* Bergh.
(Eliot: "Nudibranchs of S. India & Ceylon," Proc. Zool. Soc. 1906, p. 643.)

Nine specimens found on sponges dredged at Port Tewfik and Suez. The following are Mr. Crossland's notes on one of the Port Tewfik specimens:—"Elongate, high body with a narrow mantle, which however is kept down in crawling. Length 1·6 cm., breadth 0·35 cm. Gills 11, small, the anterior ones largest, set in a circle open behind. Pinnules very small; a vermilion band on outer and inner edges of gills: the rest white. Both the rhinophores and gills are retracted with difficulty and soon reappear: the rhinophores are taller than the gills. Colour creamy white with bluish-grey mottlings. Both colours have deeper tints on raised blotches, the former becoming rich cream and quite yellow towards the mantle-edge, the latter like blue-black ink with pure vivid dark blue at the margins in some cases. In front of the rhinophores are three black and two cream-coloured blotches. The foot is very light blue with blue and blue-black spots. There is little cream-colour except near the edges. The foot projects behind the mantle when the animal is crawling."

The preserved specimens are of a greyish colour with markings (which take the form of dots as well as of larger blotches) of dark blue and

yellowish white. The blue markings show no tendency to arrange themselves in lines, but in one specimen the yellowish spots are confluent and form a medio-dorsal stripe from the rhinophores to the branchiæ.

I have endeavoured to show (*l. c.*) that Bergh's *Chr. semperi* ought to bear the earlier name given by Kelaart, and also that *Chr. nigrostriata*, Eliot, and *Chr. tenuilinearis*, Farran, are merely varieties of the same species. If *Chr. diardii* is recognized as the specific name, then var. *semperi* will be the variety in which the coloration is composed wholly or mainly of spots, blue and yellow; var. *tenuilinearis* will be the pale variety with greenish lines; var. *nigrostriata* the violet-coloured variety with yellow spots and lines of black or deep blue, while the yellow variety with black stripes will be var. *flava*. (See Eliot, in Proc. Zool. Soc. 1904, p. 395, and Journ. of Conchology, 1905, p. 246.)

In a letter just received, Mr. Crossland reports that "a blue *Chromodoris* of a species common in Zanzibar," by which he probably means the present animal, is distasteful to fish. He says: "I threw in the Chromodoris to see whether its colour would be any protection to it. About half a dozen fish dashed up at once, but only touched it with their mouths and turned away directly. Their getting so close to it leaves me in doubt whether they were repelled by its smell or colour. I think smell is negatived because (1) none is perceptible to human senses as in *Ceratosoma*, &c.; (2) the same fish devour, *e. g.*, the guts of *Balistes* which had been in formalin over night, and even the flesh of specimens of *Margaritifera vulgaris* which had been in formalin for three weeks."

CHROMODORIS QUADRICOLOR (*Rüppell & Leuckart*).

(See Bergh: Mal. Unters. in Semper's Reisen, VI. ii. 1905, p. 68, and 'Siboga'-Expeditie, 1905, p. 143. Bergh originally described the species as *Chr. Elizabethina*, but subsequently identified it with Rüppell & Leuckart's *Doris quadricolor*.)

Three specimens from Mersa ar-rakiya, where they were found on a piece of leafy sponge in half a fathom of water, and one from Engineer Island. The notes on the first three specimens are as follows:—"In all three specimens there is much more black than white, and the white stripes on the dorsum and the sides are of a bluish tint. The stripe round the edge inside the yellow is pure white. In two specimens the yellow is rich and nearly pure, but in the third the border of the mantle is dirty white with a yellowish tinge and the white stripes on the back are broader *. The white stripes bifurcate behind the rhinophores and they join behind the gills. There are two white stripes on the sides of the body, as well as those under the edge of the mantle and at the edge of the foot. All the specimens are

* As preserved, the back might almost be described as a white background bearing black bands.

much the same size: 7·3 cm. long, 2 cm. broad, and 2 cm. high. In one specimen the gills are quite regular, long, unbranched plumes with minute white pinnæ, 12 in number. In another specimen, most of the gills bear small branches near their tips. In the grey specimen they are very irregular and there are numerous small ones at the turned-in ends of the line." (I understand this to mean that the branchiæ are set in an incomplete circle and that those at the point nearest the gap turn inwards. At this point there are numerous small plumes.)

The specimen from Engineer Island, which is preserved in formol, has the branchiæ and rhinophores of a brilliant orange, and a line of the same colour round the mantle and foot. The other specimens have become black and white. They are all remarkably large.

Chromodoris maculosa, *Pease.*

(Pease: Amer. Journ. of Conchology, 1872, vol. vii. p. 16, pl. 7. fig. 1 *.)

The notes on the living animal are as follows:—"Dorid from coral nullipore reef at the Beacon, Khor Dongola. Elongated and rather flat: mantle broad, especially over head. Foot ends in sharp point projecting behind mantle. Rhinophores long and erect. Gills small and thick, seven in number, simply pinnate, the two hindmost smaller. Foot grooved in front, and the groove has thickened edges. Tentacles finger-like.

"Colour in the centre a translucent greyish pink. Round this a broad undefined band of opaque white, and outside, bordering the mantle, a broad transparent orange-yellow line interrupted by opaque white spots along the edge. The gills have yellow tips, but the rhinophores are colourless at the base and translucent white in the perfoliate parts. Over the central area extend clear-cut lines of opaque white, running longitudinally but not quite regularly or quite continuously. Round spots of dark crimson-lake are sparsely distributed over the same area. The foot &c. are quite white but for a row of these spots along the side."

The preserved specimen is high and rectangular in shape, 6·5 mm. long, 3 mm. broad, and 2·7 mm. high. The ample mantle-margin, long tail, and lines on the back are still noticeable. The other markings have disappeared.

The labial armature consists of a ring (which is broken or incomplete) formed of bifid, slightly bent rods. The formula of the radula is about $33 \times 35 . 0 . 35$. The innermost teeth almost meet across the rhachis; they are stout and rather flat, with about 6 denticles outside, and on the inside a shoulder bearing 2–3 denticles. The second and third teeth are also stout and flat. The subsequent teeth become more slender and erect, with 8–10 distinct denticles. The outermost are small and degraded with 4–5 denticles on the tip.

If allowance is made for the fluctuation in colour which is so common in *Chromodoris*, it seems permissible to regard this specimen as a rather pale

variety of *Chr. maculosa* *, which has a yellow margin, opaque white lines on the back, purple spots, and 8 branchiæ with red tips. Its buccal parts are unknown.

It is also very probable that this specimen is a colour variety of one of the species described by Rüppell or Ehrenberg from the Red Sea.

CHROMODORIS PALLIDA (*Rüppell & Leuckart*).

(*Doris pallida*, Rüppell & Leuckart, Neue Wirbellose Thiere des Rothen Meeres, 1828, p. 32.)

Chr. marginata, Pease, Proc. Zool. Soc. 1860, p. 30; and Bergh, 'Siboga'-Expeditie, 1905, p. 150.

Chr. inornata, Pease: Amer. Journ. of Conchol. vol. vii. I. 1871 p. 18; and Bergh, Mal. Unters. in Semper's Reisen, Supp. i. 1880, p. 21.)

Two small specimens (about 9 mm. long and 6 mm. broad) collected by Mr. J. G. Logan of Suez. The notes merely say, "White markings with yellow border to mantle."

The preserved specimens are stoutly built, rather high and rectangular in shape, with a narrow mantle-margin. The ground-colour is greyish brown, but there is a whitish border to the mantle and a considerable amount of whitish colour on the dorsal surface. It is distributed over a large patch in the centre, which is connected by two stripes with a line running round the branchial pocket, and adjoins another patch of roughly triangular shape between the rhinophores. The branchiæ are 7 or 8, with a very distinct white stripe on the outside of the rhachis.

The labial armature is strong and is formed of bent rods with a small denticle below the tip, so that from some points of view they look bifid and from others entire. The radula is long and narrow with a formula of about $150 \times 30 . F . 30$, where F is a median "false tooth." The outline of its sides and apex is clear and well defined, but the base is indistinct. The three teeth nearest to the rhachis are rather broad and flat. The one next to the median "false tooth" is as usual in the genus and bears about 4 denticles on the inner side. The remaining teeth are hamate, strongly bent, and generally bear 8 denticles, sometimes 9 or 10.

These specimens are almost certainly the same as the animal identified by Bergh with *Chr. marginata*, Pease (1860), but are also probably identical with the much older (1828) *Doris pallida* of Rüppell & Leuckart, which was found in the Red Sea. *Chr. inornata*, Pease, is another closely allied form.

* Pease's references (*l. c.* pages 15–16) to the figures in his plate seem to be wrong. Figs. 1 *a*–1 *d* are clearly the animal described as *Chr. maculosa*, and 2 *a*–2 *c* the animal described as *Chr. variegata*, but the numbering has been accidentally transposed.

Chromodoris inornata, *Pease.*

(Pease, Amer. Journ. of Conchol. vol. vii. I. 1871, p. 18; and Bergh: Mal. Unters. in Semper's Reisen, Suppl. i. 1880, p. 21.)

One specimen. The living animal was about 1½ inches long, rather narrow in shape but flattish with an ample mantle-margin, behind which the foot projected for some distance. The texture was very soft and delicate; the gills small. The colour was a rather translucent white with oval spots of dark violet; the mantle and foot were edged with bright yellow, and the rhinophores and branchiæ were also bright yellow.

The preserved specimen is much bent, but apparently about 18 mm. long and 6·5 mm. broad. The gills are 12 in number or perhaps 11, one plume being bifid. The labial armature is a complete distinct ring composed of bent rods, bifid at the tip. The radula consists of about 70 rows containing 40–50 teeth on either side of the rhachis. The innermost and outermost teeth have the structure usual in the genus. The innermost bear 3–4 denticles on the side next to the rhachis. The remaining teeth are tall, erect, and bear six very distinct denticles rather high up.

This seems to be the *Chr. inornata* of Pease and Bergh, and is possibly a variety of the last species.

Thorunna furtiva, *Bergh.*

(Bergh: Mal. Unters. in Semper's Reisen, Heft xiii. 1878, p. 575.)

One specimen dredged in three fathoms, near Engineer Island, Khor Dongola, on a sandy bottom yielding sponge, weed, and polyzoa.

The living animal was shaped like a *Chromodoris*, and of a pinkish-white colour with a narrow border of bright yellow running round the mantle. The gills had each a strip of vermilion on the outer side, and the rhinophores were tipped with the same colour.

The preserved specimen is 8·5 mm. long and 3·5 mm. wide. It is greyish yellow with a vivid white border, and has all the external characters of a typical *Chromodoris*. The rhinophores are exserted and very large; the branchiæ retracted into the pocket and apparently 11 in number.

No trace of a labial armature was found, and its absence seems certain. The radula is very small and has a formula of about $25 \times 20 . 0 . 20$. The teeth are as described and figured by Bergh. The innermost are large and bear near the tip 4–5 denticles which are difficult to see, since in the preparation made of the radula the teeth present themselves vertically to the observer. The remaining teeth are tall and slender, bifid at the tip but not otherwise denticulate. The second tooth is larger than those which follow it.

This is undoubtedly Bergh's *Th. furtiva.* Its appearance when alive is now described for the first time.

PLATYDORIS INCERTA, *Eliot*, juv.

(Eliot: Proc. Zool. Soc. 1903, vol. ii. p. 378.)

One small specimen. Locality not mentioned. The notes on the living animal are as follows :—

"Found on a smooth leafy sponge of a grey-green colour. The nudibranch is of very nearly the same tint, except for a slightly wavy brown line from between the rhinophores nearly to the gills. Gills five, small, bipinnate: their pinnules are of a darker grey than the body. The perfoliated parts of the rhinophores are yellowish brown.

"Foot broad: grooved and notched in front. Oral tentacles distinct and fairly long."

In the preserved specimen the rhinophores are retracted and the pockets are large holes with edges not much raised. The branchial pocket is stellate. There is no labial armature. The radula consists of 60 rows, containing 20–30 teeth on each side of the rhachis. The teeth are hamate, colourless, and increase in size as they are further from the rhachis. The outermost are degraded but not denticulate. The vas deferens bears a thick armature of spines on stout bases, of the type characteristic of the genus.

These specimens seem to belong to *Pl. incerta* described by me from Zanzibar, which is probably the young of some other species.

DISCODORIS AMBOINENSIS (?), *Bergh*, juv.

(Bergh: Mal. Unters. in Semper's Reisen, Heft xvii. 1890, p. 895.)

One specimen unaccompanied by notes. It is flat, 21·5 mm. long, 18 mm. broad, and the shape and external characters are as usual in the genus. The rhinophore pockets are slightly raised and the branchial pocket is crenulated. The branchiæ are five or six. The back is granulate or papulate, yellowish brown with darker mottlings. The coloration of the under side is similar, but the mottlings are concentrated in more distinct purplish spots. The labial armature is an incomplete ring composed of yellow rods. The formula of the radula is about $26 \times 40 . 0 . 40$. The teeth are of the ordinary hamate type: the outermost are small and slender but not denticulate. The genitalia are not armed in any way.

This appears to be an immature *Discodoris*, perhaps *D. amboinensis*.

Another small *Discodoris* from Dongonab was received, in a slimy and semi-decomposed condition. The entire mantle-margin had been cast off by autotomy and remained as a separate complete ring. The animal is perhaps a young specimen of *Discodoris fragilis*, Alder & Hancock.

KENTRODORIS LABIALIS, sp. nov.

(? = *Doris setosa*, Pease, Proc. Zool. Soc. 1860, p. 26.)

Two specimens which though somewhat different in appearance were correctly referred by Mr. Crossland to the same species. Of the first, which was found under a stone on the mud-flats of Suez, he says :—" Dirty white, with inconspicuous round light brown spots which look like pits, but are not. Back covered with bundles of hairs (? spicules) which form a fringe to mantle and gill-pocket. Back rounded ; foot narrow, deeply grooved and notched ; oral tentacles finger-like." The second was found at Suakim on a shell of *Margaritifera vulgaris* attached to a buoy. Mr. Crossland says of it :— " Not very like the first specimen except for the tufts of hair-like spicules which cover it. Colour a very dark dull grey with sandy spots round mantle-edge and on the rhinophores and tips of gills. Gills long and rather slender, resembling those of a Chromodorid, but bipinnate, with numerous delicate branchlets."

Both specimens, as preserved, are much contracted and rolled up into balls, though they appear to have been naturally flat. The largest is about 12 mm. long and 7 mm. broad. The mantle-margin is ample. The pockets of the rhinophores and branchiæ are not raised. The back is covered with fusiform tubercles, somewhat swollen below the tips. The whole dorsal surface is full of spicules, which project freely from the tips of the tubercles. The spicules are fairly straight, not branched, and have a granulated appearance externally. The branchiæ are completely retracted ; at least 8 in number, and possibly 10, two plumes being very small. The foot is narrow, with a rather long free tail. The anterior margin is deeply grooved ; the upper lamina is notched in the middle and forms two ample lappets.

The blood-gland is purplish. The central nervous system is enclosed in a capsule which is spotted with purplish brown. Within the capsule are three pairs of fairly distinct yellow ganglia. The eyes are large and sessile with yellowish lenses.

A small labial armature consisting of fibrous-looking rods, somewhat swollen at the tips, was found. In both specimens it appeared as two plates, but they possibly represent a semicircular armature broken in two. The formula of the radula was in one specimen $20 \times 18 . 0 . 18$, and in the other $24 \times 18 . 0 . 18$. Some of the rows were shorter, but none contained more than 18 teeth. The teeth are simply hamate and erect, without a trace of denticulation. The innermost are hard to see, but apparently do not differ from the others in shape. The teeth increase in size from the inside outwards but the tips are often broken, which gives the row an irregular appearance. The outermost teeth are smaller and slender.

The hermaphrodite gland forms a white layer on the liver. The genitalia seem to be immature, and it is probable that the specimens are not full-grown,

but the verge bears a long, curved, pointed, colourless stylet, which seems to be enclosed in a special sheath.

These specimens resemble *Kentrodoris* (especially *K. maculosa*) in most characters—the texture, the lappets formed by the margin of the foot, the stylet, and the short radula—but they differ in having a small but distinct labial armature. This brings them near *Audura*, but *Audura* has a different texture and denticulate teeth. They seem to be midway between *Audura* and *Kentrodoris*, but closer to the latter, to which they are here referred, the principal specific characters being the labial armature and the long slender branchiæ.

It is extremely probable that this form is the *Doris setosa* of Pease, but Pease gives no account of the mouth-parts or genitalia, and his figure does not show the lappets of the foot or agree in all the details of coloration. The identity cannot therefore be regarded as established.

Peronodoris, *Bergh.*

(Bergh: Malac. Unters. in Semper's Reisen, VI. i. 1904, p. 44, ff.)

It appears to me that the genera *Peronodoris*, Bergh, *Halgerda*, Bergh, *Dictyodoris*, Bergh, *Asteronotus*, Bergh, and *Sclerodoris*, Eliot, are more nearly allied than appears from Bergh's classification, in which they are arranged under three subfamilies—the first in Archidorididæ, the second in Diaululidæ, the third and fourth in Platydorididæ. They are all characterized externally by the presence of ridges on the back, but except for these ridges the skin is smooth or minutely granulated, not villous or papillate and not regularly tuberculate, although there may be tubercles on the ridges (especially at the points of junction) or more rarely separate tubercles near the ridges. The internal organs are much as in *Archidoris*. There is no labial armature; the teeth rarely bear any denticles and the genitalia are not armed with hooks or spines. They show, however, a tendency to develop a stylet, in *Peronodoris* on the end of the verge, in *Asteronotus* near the female orifice.

The genera and species may perhaps be tabulated as follows:—

A. No armature on the genitalia.

I. *Halgerda*, Bergh. Texture not hard or rough but leathery, or in some species like a stiff smooth jelly. Branchial pocket roundish. External teeth of radula sometimes pectinate.

1. *H. formosa*, Bergh.
2. *H. apiculata*, Alder & Hancock.
3. *H. punctata*, Farran. These two species are probably identical.
4. *H.* (*Dictyodoris*) *tessellata*, Bergh.
5. *H. wasinensis*, Eliot.
6. *H.* (*Dictyodoris*) *maculata* (Eliot). This species is probably the young of the last.
7. *H. willeyi*, Eliot, 1903.
8. *H. graphica*, Basedow & Hedley, 1905. These two species are probably identical.
9. *H. elegans*, Bergh.

10. *Halgerda rubra*, Bergh. (= *Sclerodoris rubra*, Eliot.)
11. } *H. inornata*, Bergh, 1905.
12. } *H. coriacea* (Eliot) 1903. These two species are probably identical.

II. *Sclerodoris*, Eliot. Texture hard and rough, much as in *Platydoris*. Branchial pocket with lobes or teeth. External teeth of radula not pectinate in known species.
1. *Scl. tuberculata*, Eliot.
2. *Scl. osseosa* (Kelaart).
3. *Scl. minor*, Eliot.

B. An armature on the genitalia.

III. *Perconodoris*, Bergh. Body rather hard. Branchial pocket toothed or tuberculate. Inner teeth of radula sometimes with a few denticles. A stylet on the verge.
1. *P. cancellata*, Bergh.
2. *P. denticulata*, sp. nov.

IV. *Asteronotus*, Ehrenberg. Large animals with a texture resembling *Halgerda*. Branchial pocket strongly toothed. Teeth of radula not denticulate. Glandula et hasta amatoria near the female orifice.
1. } *A. hemprichi*, Ehrenberg.
2. } *A. cespitosus* (von Hasselt).
3. } *A. mabilla*, Bergh. These three species are probably varieties of one form.

In the above arrangement I have regarded *Dictyodoris* as identical with *Halgerda*, and I doubt if my genus *Sclerodoris* will prove valid. After creating it I withdrew it as probably equivalent to Bergh's *Peronodoris*, which has priority. But perhaps it may be well to retain it provisionally. The stylet of *Peronodoris* is a more important character than an armature of spines and scales, which are little more than a thickening of the skin, for it represents more than they do the development of a new organ. Also the harsh rough texture of *Scl. tuberculata* and *Scl. osseosa* seems to me quite different from the texture of *Halgerda*.

I regard my *Sclerodoris rubra* as certainly the same as Bergh's *Halgerda rubra*, and my *Scl. coriacea* as being probably his *Halgerda inornata*. In excluding these species from *Halgerda* I was influenced by Bergh's definition of the genus in the 'System der Nudibranchiaten Gasteropoden' (... Tentacula parva ... podarium sat angustum. Dentes pleurales extimi apice serrulati). But if that definition is made more elastic, I see no reason why these forms should not be included in *Halgerda*, except that my specimen of *H. rubra* has a hard rough torch unusual in the genus.

This group of Dorids runs into *Staurodoris* on the one side, for it is very hard to draw a line between forms which are typically tuberculate but have the tubercles connected by ridges, and forms which are typically ridged but develop tubercles on the ridges. On the other side the group runs into *Platydoris*, such a form as *Hoplodoris* being intermediate between that genus and *Asteronotus*.

PERONODORIS DENTICULATA, sp. nov.

The notes on the two living animals are as follows :—(1) " Regular oval shape ; high back. Very sluggish. The back is ridged all over, more or less in a network pattern, but the main lines are one longitudinal mid-dorsal and others running out laterally. Six gills, bipinnate, small, sparsely and irregularly branched, grey but bright light yellow in the distal parts. Rhinophores of the same colour. Gill-pocket with six teeth, of which the posterior is much the largest. Measurements $1{\cdot}3 \times 1{\cdot}0$ cm. General colour a cool grey, formed by specks on a whitish ground, and there are small white dots scattered about. The ridges are of a darker tint, more of the grey specks being present on them, and at intervals are raised into small light yellow warts which are especially well developed where two of the ridges meet or cross. Found by diver, Suakim Harbour, one or two fathoms."—(2) " Picked up from the deck after divers had brought in a quantity of coral. In many respects like the preceding specimen, *e. g.*, in having a raised network and warts, though the arrangement of the ridges is not so regular. The gills also correspond. Body rather stiff and leathery, but not harsh to the touch : like india-rubber. Foot narrow. Animal fairly active. Oral tentacles long. Ground-colour a mixture of grey, light and dark brown, and yellow, the brown being confined to the visceral mass ; at junction of this and the mantle are large oval brown spots, four on the left, two on the right side. Under side yellowish white with specks of brown. The raised network and the warts are yellow."

The preserved specimens agree fairly well with the above description. The edges of the rhinophore pockets are slightly raised and bear short irregular processes. The branchial pocket is also slightly raised and partially closed by not very distinct tubercles. The anterior margin of the foot is grooved, but it is not clear if the upper lamina is notched. The oral tentacles are short, stout, and distinct.

The blood-gland is greyish, thin and shadowy. The central nervous system is strongly granulated and distinctly divided into two halves, each half being less distinctly divided into three ganglia. The salivary glands are short and rather thick. The formula of the radula is in one specimen $32 \times 30 \,.\, 0 \,.\, 30$ in the longest rows, and in the other $28 \times 28 \,.\, 0 \,.\, 28$. The teeth are hamate and increase in size outwards. The innermost have long bases and low hooks ; those in the outer third of the row are large and stout ; the last three are smaller but not denticulate, though sometimes jagged. A few of the inner teeth (in one specimen the first four counting from the rhachis, in the other the first six or seven) bear one minute denticle, more rarely two, on the outer side. The tooth next to the rhachis has also a denticle on the inner side. The denticles are larger in one specimen than in the other. No labial armature was found. The vas deferens is short and unarmed. The

penis terminates in a yellowish slightly bent stylet, exactly as in Bergh's figures of *Peronodoris cancellata*. The spicules in the integuments are not branched, but sometimes bent and jointed.

These specimens clearly belong to *Peronodoris*, and might be identified with *P. cancellata* but for the presence of a few denticles on the inner teeth. Also the branchial pocket is toothed.

Asteronotus hemprichi, *Ehrenberg*.

(See Eliot, Proc. Zool. Soc. 1903, vol. ii. p. 384.)

One very large specimen unaccompanied by notes. Even in its preserved and bent condition it is 130 mm. long and 100 mm. broad. The general colour is olive-green but the larger warts are bluish. There is a distinct median ridge. The branchial pocket is closed by six very distinct teeth, but the whitish branchiæ can be seen through them at the bottom. There is a very broad and distinct chocolate band on the under side of the mantle.

I doubt if the species of *Asteronotus* which have been described are more than varieties, and *hemprichi* certainly has priority as a specific name. The present specimen comes nearest to *A. cespitosa* (Van Hasselt), if that form is recognized as a valid species.

Artachæa clavata, *Eliot*.

(Eliot, in Journ. of Conchology, 1907, p. 81.)

One specimen. The notes merely say that it came from Engineer Island and was a "grey-brown dorid with warts and chocolate blotches under the mantle." The internal characters and, in essential points, the external characters leave little doubt that it is *A. clavata*, but superficially it is not like the specimens previously found in Zanzibar and resembles rather Bergh's figure of *Phialodoris podotria* ('Malacologische Untersuchungen,' in Semper's Reisen, Heft xvii. 1890, pl. 85. figs. 5, 6). The ground-colour is greyish white covered with low warts of a brighter white. The interstices between these warts bear mottlings and also dots of chocolate, and the whole dorsal surface displays a reticulate or stellate pattern formed by spicules radiating from the warts. This pattern is even clearer on the under side of the mantle. The rhinophores and branchiæ are both large and remarkably transparent and delicate. The labial armature, radula ($20 \times 50 . 0 . 50$), and genitalia are as described for *Artachæa clavata*, l. c.

Artachæa verrucosa, sp. nov.

(?=*A. rubida*, Bergh, "Beiträge zur Kenntnis des Japanischen Nudibranchien, II.," in Verh. der k.-k. zool.-bot. Gesellschaft in Wien, 1881, p. 231.)

The notes on the living animal are as follows:—

"Three specimens, one from 5, two from 10 fathoms in Suez Bay. 3 cm. ×

1·3 cm. Of the typical shape, neither flat nor high, soft but firm in texture. Gills six, rather small, tripinnate, completely retractile; pockets drawn out transversely and anterior lip trilobed. Foot in crawling moderately broad, but becomes very narrow when the beast is laid on its back.

"Of somewhat varying colour. One specimen is on the whole brown; another grey with but little brown; the third intermediate between the two. The back is quite covered with warts, round and of different sizes. They are light brown, mottled with opaque white or light drab. The narrow spaces between the warts are brown, with more or fewer chocolate marks. The depth of this colour varies in different parts, so that the body is mottled grey and brown."

The preserved specimens correspond fairly well with this description. The anterior margin of the foot is grooved and the upper lamina notched. The rhinophore pockets are protected by two not very conspicuous valve-like tubercles, between which on both sides are a number of small tubercles. There are also tubercles on the rim of the branchial pocket, but though distinct they are not specially modified.

The integuments are not very hard, but full of white spicules, fairly straight but often jointed or broken. The liver and other internal organs are brown or grey of various shades. The blood-gland is large, thick, and greyish white. The central nervous system is granular and somewhat concentrated, the two sides as well as their component ganglia being close together. The division between the cerebral and pleural ganglia is not clear. The pedal ganglia are set on a distinctly lower level, somewhat at the sides of the œsophagus.

In the two specimens dissected no trace of a labial armature was found. In both the radula is somewhat crowded and disordered. It consists of 25 rows in one specimen and of 27 in the other. In the first the number of teeth on each side of the row does not much exceed 40; in the other it is as much as 55 in some rows. There is no central tooth. The first lateral is rather broader than the others and bears three or four denticles on both sides. These denticles are rather irregular and extremely difficult to see, as the tooth stands vertically and I was not successful in obtaining a side-view, but their presence is certain. About the ten outermost teeth bear a variable number (5–12) of very irregular small denticles on the lower side of the hook. The remaining teeth are apparently smooth and simply hamate. The outermost six teeth or so are thinner than the others and sickle-shaped, with smaller bases. This formation is more conspicuous in one specimen than in the other.

On issuing from the buccal mass the œsophagus is about 1 mm. broad, but it expands shortly afterwards into a dilatation about 4 mm. long and 3 mm. broad. After this it again contracts to its original dimensions and runs into the liver. There is no stomach outside the liver, and it would appear that

the liver-cavity acts as a stomach. The liver, though, as usual in Dorids, forming one mass, is very loose and easily falls to pieces.

The hermaphrodite gland forms a very thin layer spread over the liver. The penis is armed with hamate spines arranged in rows but apparently not extending to the vas deferens.

I do not see how this form can be identified with Bergh's *A. rubida* on account of the very distinct difference in the inner teeth. There are also minor discrepancies, *e. g.* in *A. rubida* the anterior margin of the foot is said not to be clearly grooved. But the two species are nearly allied.

Four more specimens from Dongonab were subsequently received from Mr. Crossland in February 1898. They are about 35 mm. long and 17 mm. wide. Three are flat, rather soft, with broad feet expanded into thin margins; the fourth is harder, more convex, and the foot is narrower. The colour of all is orange-brown of various shades. The pigment is distributed chiefly between the warts in a reticulate pattern and is darker in some places than others, producing an impression of blotches. The warts are sometimes plain grey and sometimes bear 1–3 brown dots. The branchiæ are 6–7, rather long and thin and usually only bipinnate, though tripinnate plumes also occur. No labial armature was found, but in one specimen the labial cuticle bears a patch of granules or very minute rods not connected into a plate. The radulæ are about $60 \times 30 . 0 . 30$. The three or four denticles on the innermost teeth are very clear and distinct, but the small denticles on the outer teeth are inconspicuous and seem to be reduced to minute ridges.

Doridopsis rubra (*Kelaart*).

(See Eliot, in Proc. Zool. Soc. 1904, vol. ii. p. 279.)

The notes on the living animals are as follows:—

"(*a*) In tidal stream of salt water near the canal. Exactly like a Dorid in shape, but rhinophores are not retractile into pockets but merely shrink into shallow depressions when touched. There is a shallow gill-pocket, but the gills are not retractile into it. They are five, bipinnate, and set in a circle open behind. There are no proper oral tentacles; in their place is a pair of dull yellow, slightly projecting flaps. Colour, a transparent pink, but dorsally this is hidden except at margin and tips of rhinophores by sooty pigment evenly distributed, but also found in denser irregularly scattered blotches. Under surface of foot pink.

"(*b*) Later from the same locality, two more specimens; more pink, *e. g.* rhinophores quite red with white tips. Rhinophores and gills can be retracted a good deal when the animal is lively, but far from being put out of sight. Largest specimen measures 3·8 cm. × 1·7 cm. and foot projects a little behind the mantle.

"(c) Kal el Kebira shoal in Suez bay, among corals. A good-sized specimen in which the gills and rhinophores were completely retracted.

"(d) Reef-edge of Tella Tella Kebira, an island of the Suakim group. Gills tripinnate, not retracted. Rhinophores partially retracted. Colour red, with mottlings of brown dorsally."

All these specimens seem to be *Doridopsis rubra.* In those dissected the œsophagus (as seen dorsally) turns to the right and then forward, describing a complete loop and passing under itself. Close to this point are the small but distinct salivary glands. After describing the loop the œsophagus gradually dilates and runs backwards, tending somewhat to the left until it enters the liver. In specimens from other localities which I have examined the œsophagus though bent does not form a complete loop.

The interest of these specimens lies in the fact that they offer a series of stages in which a normally cryptobranchiate Dorid becomes almost completely phanerobranchiate. There can be no doubt of the reality of the phenomenon, for it is vouched for by Mr. Crossland's notes on the living animals as well as by the condition of the preserved specimens. In many species of *Doridopsis* the branchiæ are habitually everted and not easily retractile into the pocket. This seems to be due to the thinness of the integuments. A hard and thick gill-pocket forces the visceral mass to find room for it, but when the integuments which form and surround the pocket are thin membranes, the visceral mass tends to expand beneath it and to press its floor upwards. The branchiæ are thus driven outwards, and doubtless the more they are exposed the hardier, thicker, and larger they grow, and therefore it is more and more difficult to find room for them in the delicate pocket which gradually becomes disused and atrophied. In one of the present specimens there is no sign of the pocket except an inconspicuous circular fold of skin running round the base of the stout branchial plumes. The rhinophore pockets, though plain in some specimens, seem to have altogether atrophied in others.

It seems natural to suppose that the phanerobranchiate condition is the more primitive and that the branchial pocket is a later specialization, but these specimens indicate that in some cases at any rate variation may take the opposite direction and that cryptobranchiate forms may become phanerobranchiate.

Doridopsis nigra (*Stimpson*).

(See Eliot, Proc. Zool. Soc. 1904, vol. ii. p. 275, and authorities there quoted.)

Several specimens from the mud-flats near Suez, where the animals were found under stones and in the cavities of a red sponge which they probably eat. They were also found with orange-coloured egg-ribbons which they had probably laid. All the specimens appear to belong to the smooth black variety, which has no spots but a light border round the mantle and foot.

In some there was, according to Mr. Crossland's notes, a distinct orange border; in others only a little whitish or reddish colour near the mantle-edge. The living animals are said to have attained a length of 8 cm., but the preserved specimens have shrunk considerably. The anatomy of those opened proved to be as usual in this species.

DORIDOPSIS sp.

The notes on the living animal are as follows:—"When actively crawling, peculiarly elongated, measuring 4 cm. by 1·2 cm. The wavy mantle-edge is kept applied to the substratum. Rhinophores straight, perfoliated half their length, basal part thick. Gills small and sensitive, rarely seen, tripinnate, 4 (?) in number, white with grey rhachis. The gill-pocket is generally closed and its place marked by wrinkles. The rhinophores also are completely and readily retractile. The mantle is moderately ample. The general texture is soft but firm. The colour is translucent white with large and small spots of opaque white (which are thickened places in the skin) and sooty spots of black like fallen smuts. The viscera show through as bright pink."

The animal as preserved was shrunken and hardened, but the buccal parts seemed to be as in *D. nigra*.

This may be *Doridopsis atromaculata* but no dorsal papillæ are mentioned, nor are they visible in the preserved specimen. It may also be *D. bataviensis*.

PHYLLIDIA VARICOSA, *Lamarck*.

(Bergh: Bidr. til en Monogr. af Phyllidierne, 1869, p. 500.)

The notes on the living animal say:—"On sand among coral at the edge of the shore-reef; seen at a depth of about a fathom and obtained by a diver. 6 cm. long and 3 cm. broad. Jet-black with raised warts of a dirty greenish white, which are very high and bear small secondary warts; the tops of these are brilliant orange. The rhinophores are also orange and were kept retracted though the animal was continually crawling. The largest warts are arranged one behind the other in five longitudinal rows down the back. From the outermost of these rows low bands of greenish grey bearing small warts go to the mantle-edge."

The orange tips are harder than the rest of the epidermis.

Additional Note, received 23rd June, 1908.

MARIONIA CYANOBRANCHIATA (*Rüppell & Leuckart*).

(Rüppell & Leuckart: Neue Wirbellose Thiere des Rothen Meeres, p. 16, pl. iv. fig. 3, 1828).

One specimen found outside Dongonab harbour in one fathom of water crawling among pearl shells on a coral and mud bottom.

Mr. Crossland says of the living animal :—

"Length 45 mm., breadth of body 10 mm., total breadth (inclusive of appendages) 27 mm. Rhinophores as usual. Velum with five tentacular projections on each side, of which the middle one on each side is long, the outermost is spatulate. Body not so high and square in section as in *Tritonia*, lower and more rounded. Foot broad.

"The dorsal appendages are remarkably large; there are 9 pairs, all of which are large except the hindmost. They increase in size from the head to the middle of the body, after which size remains practically the same with exception of the last pair. They are six times branched; this complication of branching and their size and shape recall the gills of a Dorid.

"The normal position of the main stem is at 45° to the vertical, the smaller branches spread out more or less in one plane, and the plumes cover most of the back and all the space between consecutive appendages.

"Colour very striking. Body primrose-yellow, orange along sides of back. Thicker branches of gills also light yellow, but the finer branches are a light bluish green. This colour is also found on the velum and covers the rhinophores. On the middle of the back is a network of blotches of umber-brown.

"As the creature crawls the anterior appendages rhythmically bend over the back and then outwards; the motion arises in the bases of the main stems, not by contractions of the dorsal body-wall.

"In spirit the back appears rather warty; it was not so in life, and I do not know to what the warts correspond, possibly to yellow dots enclosed by the brown network."

As preserved, the animal has entirely lost its beautiful colour and is of the brownish tint usual in alcoholic specimens, but traces of bright light yellow remain on the branchiæ.

The shape is as described by Mr. Crossland and also corresponds with Rüppell and Leuckart's figure. The foot, as preserved, is pointed in front with a line or very shallow groove on the anterior margin. The tail is short and hidden by the posterior branchiæ. The genital orifices are on the side, below and between the first and second branchiæ. The anus is latero-dorsal and lies just in front of the fourth branchia. The rhinophore-sheaths are rather tall, with wavy but not denticulate margins; the club is surrounded by branched processes which adhere closely to it. The branchiæ look like small trees. There is at the base a thick, longish common stem; this divides into three main branches, which are again subdivided into three, and these subdivisions are tripinnate. In all the plumes the division seems to be with few exceptions consistently tripartite.

When the animal is opened, the large heart and pericardium are conspicuous objects lying almost in the centre and only slightly to the right of the median line. The central nervous system is as depicted in Bergh's plates of

Tritonia hombergii ('Malacologische Untersuchungen,' in Semper's Reisen, pl. lxxiii. fig. 1).

The jaws are thin and transparent. No striation or tessellated appearance is visible. The edge bears a single row of large and distinct denticles. The radula consists of 49 rows with a formula of 30+1+1+1+30 as a maximum, but the rows in front are much reduced and the first consists of the median tooth only. The median tooth is broad and bears three cusps, but as the corners are also raised it might be called five-cusped. The central cusp sometimes bears an inconspicuous denticle on either side. The first lateral is as usual in the genus. The rest are simple, without denticles, and erect; the inner ones are rather thick; those nearer the end of the row are much thinner and more elegant. The outermost of all is smaller and less well formed.

The œsophagus is short. The first division of the stomach is lined with folds, which are stronger in the anterior than in the posterior part; the second division is armed with a belt of about 70 roughly triangular horny plates, striated and of different sizes. The intestine is broad and laminated internally. The liver is greenish yellow inside, but greyer outside owing to the layer of the hermaphrodite gland which covers it. The front part is hollowed out and forms two lobes which enclose the greater portion of the stomach. The hepatic mass is traversed by large ducts which have the appearance of prolongations of the stomach. An accessory portion of the liver lies under the intestine. The genitalia are as usual in the genus. The spermatotheca is empty and crushed, but apparently spherical. The vas deferens is white, much convoluted, but not very long.

This specimen may be regarded as certainly identical with the *Tritonia cyanobranchiata* of Rüppell & Leuckart, also found on corals in the Red Sea, but must be referred to the genus *Marionia* on account of the armature of plates in the stomach. The external characters and remarkable coloration agree fairly well with their plate and description except that the lower parts of the branchiæ are more decidedly yellow. It is possible that it is really only a highly coloured variety of *Marionia arborescens*, Bergh. There are considerable differences in Bergh's description of specimens referred to this form, but one of them ('Malacologische Untersuchungen,' in Semper's Reisen, p. 891) does not differ greatly from the animal here examined. It would seem that the Tritoniadæ of the Red Sea are more brilliantly coloured than in other parts of the Indo-Pacific.

The name *Marionia cyanobranchiata* has priority over *M. arborescens*, if the two prove identical. [C. E.]

TREASURER'S ACCOUNT FOR THE YEAR ENDING APRIL 30TH, 1908.

(Presented at the Anniversary Meeting, May 25th, 1908.)

Receipts and Payments of the Linnean Society from May 1st, 1907, to April 30th, 1908.

Receipts.				£	*s.*	*d.*
Balance at Bankers on 1st May, 1907				443	8	10
Interest on Investments				232	6	1
Admission Fees				264	0	0
Annual Contributions				1490	0	0
Compositions				194	0	0
Sales of Publications:—						
Transactions	£89	7	4			
Journals	101	6	9			
Proceedings and Catalogues	11	8	0			
				202	2	1
Miscellaneous Receipts				20	16	1
Donations in aid of Publications				200	0	0
Subscriptions to the Darwin-Wallace Celebration				167	14	0
				£3214	7	1

Payments.				£	*s.*	*d.*
Taxes and Insurance				10	18	9
Repairs and Furniture				71	11	0
Coals, Electric Current and Gas				52	7	7
Salaries				757	0	0
Library:—						
Books	£214	10	5			
Binding	108	14	10			
				323	5	3
Expenses of Publications:—						
Printing	£709	8	1			
Illustrations	306	13	6			
Distribution	53	3	3			
				1069	4	10
Miscellaneous Printing and Stationery				128	12	11
Petty Expenses (including Tea and Postage)				194	6	4
Investment of Compositions				180	15	0
Balance at Bankers, 30th April, 1908				426	5	5
				£3214	7	1

Investments on April 30th, 1908.

	£	*s.*	*d.*		£	*s.*	*d.*
Metropolitan $3\frac{1}{2}$ per cent.	1079	11	3	@ 102	1101	3	1
Great Indian Peninsula Railway, Annuity Class B	42	1	5	@ 21	883	9	9
Forth Bridge Railway 4 per cent. Stock	450	0	0	@ 111	499	10	0
Metropolitan 3 per cent.	1000	0	0	@ 93	930	0	0
India 3 per cent.	700	0	0	@ $91\frac{1}{4}$	638	15	0
Metropolitan Water Board 3 per cent. Stock "B" (Westwood Bequest)	232	5	0	@ 91	211	6	11
Eastern Bengal Railway 4 per cent. Debenture Stock	1000	0	0	@ 113	1130	0	0
Great Western Railway 4 per cent. ,, ,,	1000	0	0	@ $117\frac{1}{2}$	1175	0	0
					£6569	4	9

HORACE W. MONCKTON, *Treasurer.*

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30th April, 1908, and found them correct.

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THE JOURNAL

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REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA, from Collections made by CYRIL CROSSLAND, M.A., B.Sc., F.Z.S.; together with Collections made in the Red Sea by Dr. R. HARTMEYER.—XII. The BRYOZOA. By ARTHUR WM. WATERS, F.L.S.

PART I.—CHEILOSTOMATA.

(PLATES 10–18.)

[Read 18th June, 1908.]

THIS collection has to be considered from more than one standpoint, and after the general one of learning more about the Fauna of the Red Sea we naturally turn to any work already done and recognise how much the usefulness of the splendid plates prepared by Savigny will be increased when the fauna of the Red Sea has been adequately compared. After the failure of Savigny's health, names were given by Audouin to the figures drawn by Savigny, but no description has been published; however, many of the figures have been recognised as species occurring from other localities, but concerning some there has been uncertainty. According to enquiries made in Paris none of Savigny's collection is now in existence.

The collection made by Mr. Crossland by no means fully represents the fauna, for of this there can be no doubt when such genera as *Retepora*, *Cellaria*, *Flustra*, *Hornera*, *Alcyonidium*, *Cribrilina*, &c. are unrepresented.

The Berlin Kgl. Zoologisches Museum kindly lent me a collection from the Red Sea, made by Dr. R. Hartmeyer, together with a few species collected by Messrs. Löffler and Siemens, and forms not found in the Crossland collection are described at the end of this communication; also a list of other species now known from the Red Sea is given on page 128.

Next comes the question of the distribution of Red Sea and other tropical faunas, which have so far not received as much attention as those of temperate and Arctic faunas, for until recently it was considered that the tropical Bryozoa fauna was very meagre. Having also had intrusted to me Mr. Crossland's large and important collections from Zanzibar, as well as one made by him off Cape Verde Islands, I am considering the series as practically a study of all known tropical forms*.

Some recent papers, among others those of Kirkpatrick, Philipps, and Thornely, have prepared us for finding a very wide geographical distribution of tropical forms; but notwithstanding this, after looking through practically all the British Museum specimens, which now include Busk's and Hincks's collections, examining my own collections and those upon which I am at work, there is constantly a feeling of surprise when finding species from such wide

* At present, besides the collections mentioned, the 'Siboga' and Stanley Gardiner 'Sealark' collections are in the hands of specialists, and therefore a knowledge of the Red Sea fauna, connecting the Atlantic and East, is of great importance.

areas. This is perhaps somewhat intensified in my case, through my last work having dealt with Arctic and Antarctic Bryozoa, where the faunas are so much more distinct. The analysis of the distribution is postponed for the paper on the Cyclostomata, &c.

Specimens from near the Suez Canal, where we find so many Mediterranean species, cannot be considered as reliable as those from farther down the Red Sea, for passing ships may have brought some from distant parts, and ultimately a list of species exclusive of those from Suez would be interesting. This question of artificial transport is not confined to the Red Sea, but nowhere should we be more alive to it. However, regarding this, Mr. Crossland: writes "*re* Suez forms, my examination of ships' bottoms there suggests that very few forms survive the Canal. There was a very marked difference between Red Sea steamers and those brought through from Alexandria, the former being very rich."

Points of Special Interest.

Attention must be called, in the first place, to the very wide distribution of so many species of tropical Bryozoa (see page 126); in the next, to the great variety of form and development of the oral glands, as well as their similarity in certain groups, consequently their importance in classification is explained (p. 154). It is shown that there is a group, now separated from *Cellepora* as *Holoporella*, the zooecia of which have a widely open ovicell, an operculum with a nearly straight and entire proximal edge, many of the avicularian mandibles have a collumella; also at the side of the zooecium there are, in most species, minute avicularia which have been overlooked; and the zooecia have large tubular oral glands (p. 159).

Reference is again made to *Thalamoporella* having two or three larvæ in the ovicell; also the pigment of species of *Holoporella* is mentioned and the growth of the new buds from the operculum (pp. 163, 164). I allude to the number of characters which influence the structure of the operculum, and it is now easier to understand why it is of so much use in classification (p. 161).

I cannot close this introduction without expressing my thanks to Mr. Kirkpatrick for the kind way in which he has allowed me to make frequent references to the British Museum collections, and also to Miss Thornely for assistance in examining the Manaar collections.

The literature specially dealing with the tropical forms is not large and the following are the principal works :—

Savigny, J. C.—Description de l'Egypte. Hist. nat. i. pls. 6–14.

Audouin, J. V.—Explication sommaire des Planches de Polypes de l'Egypte et de la Syrie, pub. par J. C. Savigny. 1826.*

* C. D. Sherborn, "On the Dates of the Natural History Portion of Sav. Descr. de l'Egypte," Proc. Zool. Soc. 1897, p. 285.

HASWELL, W. A.—"On some Polyzoa from the Queensland Coast." Proc. Linn. Soc. New South Wales, vol. v. p. 33–44. 1881.

HINCKS, T.—"Polyzoa from India." Ann. Mag. Nat. Hist. ser. 5, vol. xiii. p. 356. 1884.

BUSK, G.—Report on Voyage of H.M.S. 'Challenger,' vol. x. pt. xxx. Cheilostomata, 1884; do. Cyclostomata, &c. 1886.

HINCKS, T.—"Polyzoa and Hydroida of the Mergui Archipelago." Journ. Linn. Soc., Zool. vol. xxi. pp. 121–135, pl. 12. 1887.

KIRKPATRICK, R.—"Polyzoa of Mauritius." Ann. Mag. Nat. Hist. ser. 6, vol. i. p. 72. 1888.

KIRKPATRICK, R.—"Hydrozoa and Polyzoa .... in the China Sea." Ann. Mag. Nat. Hist. ser. 6, vol. v. 1890.

KIRKPATRICK, R.—"Hydroida and Polyzoa (Torres Straits)." Proc. Roy. Dublin Soc. n. s. vol. vi. 1890.

PHILIPPS, E. G.—"Report on Polyzoa collected by Dr. Willey." Willey's Zool. Results, pt. iv. p. 439. 1899.

THORNELY, L. R.—"On the Polyzoa." Herdman, Rep. on Pearl Oyster Fisheries of the Gulf of Manaar. This is shortly referred to in this paper as "Manaar." 1905.

THORNELY, L. R.—"Rep. on the Marine Polyzoa." Rec. of the Indian Museum, vol. i. pt. 3, no. 13. 1907.

With regard to Savigny's figures, there is no description. However, the Zoological Congress has decided that to obtain priority the species must have been CLEARLY AND SUFFICIENTLY DESCRIBED; but figures alone have been accepted as sufficient, and an example somewhat similar to that of Savigny's is given of Du Clos publishing figures of *Columbella*, and his names being accepted, although there was no textual description.

If we take such a case as *Catenaria Lafontii*, Aud., where the figure makes it as easy to recognise the species as if a slide had been attached, then with such a figure before us any doubt as to our knowing the species, or suggesting another name, would be simply pedantry.

Unfortunately, matters are not always so simple, and the rule just mentioned, which in one form or another occurs in all papers on nomenclature, is frequently forgotten by those who are urging the revival of old names of imperfectly described genera and species.

I have, as in previous papers, retained established generic names, even when recognising that changes in classification will shortly have to be made.

As in all my recent papers, I give the number of tentacles where there has been satisfactory material to cut. This is not likely to be one of the most useful characters in classification, but it certainly is a character which should be recorded; and we are now seeing that in many genera there is always approximately the same number, so that a great variation from the normal

Collected by Crossland.

Page		Cape Verde I.	Atlantic.	British Isles.	Mediterranean.	RED SEA, Cross.	RED SEA, Hart.	Indian Ocean.	Ceylon.	Zanzibar.	Japan.	Australasian.	Fossil.	
129	*Ætea recta*, Hincks	...	+	+	+	+	...	+	+	...	...	+	+	
129	*Synnotum aviculare*, Pieper	...	...	...	+	+	+	+	...	+	...	+	...	S. Africa, Fernando Noronha.
130	*Vittaticella Contei*, Aud.	...	...	...	+	+								
131	*Catenaria Lafontii*, Aud.	...	+	...	+	+	...	+	+	+				
132	*Scrupocellaria Jolloisii*, Aud.	...	...	...	...	+	+							
133	,, *Bertholletti*, Aud.	+	+	...	+	+								
133	,, *serrata*, nov.	...	...	...	...	+								
134	,, *mansueta*, nov.	...	...	...	...	+	+							
134	,, *scrupea*, var. *dongolensis*, nov.	...	...	...	+	+	...	...	+					
135	*Bicellaria ciliata*, L.	...	...	+	+	+	...	...	...	...	...	+	...	S. Africa.
135	*Bugula avicularia*, L.	...	...	+	+	+	...	...	...	...	...	+	...	Lifu.
135	,, *neritina*, L.	...	+B.	+	+	+	...	+	+	+	+	+		
136	,, ,, var. *minima*, nov.	...	...	...	...	+	...	...	...	+	...	+		
137	*Beania intermedia*, Hincks	...	...	...	...	+	...	+	...	...	...	+	...	Chatham I.
137	*Membranipora Savartii*, Aud.	...	+	...	...	+	+	+	+	+	...	+	+	
139	,, *bursaria*, MacG.	...	...	...	...	+	...	...	+	...	...	+		
140	,, *limosa*, nov.	...	...	...	...	+								
141	*Thalamoporella Rozieri*, Aud.	+	+	+	+	+	+	+	+	...	...	+	+	California.
142	*Tubucellaria cereoides*, Pall.	+	+	...	+	+	...	+	+	+	...	+	+	
142	*Microporella coronata*, Aud.	...	...	...	...	+	+	...	...	...	+W.	+	...	California.
143	,, *ciliata*, Pall.	...	+	+	+	+	+	+	+	...	...	+	+	
143	*Schizoporella unicornis*, Johnst.	+	+	+	+	+	...	...	+	+	+	...	+	
144	,, ,, var.	...	+	...	+	+	...	...	...	...	...	...	+	
145	,, ,, var. *ansata*, Johnst.	...	+	+	+	+	...	...	...	...	...	...	+	
146	,, *argentea*, Hincks	...	...	...	...	+	...	...	+	...	...	...	...	Tahiti, S. Africa.
147	,, *viridis*, Thorn.	...	...	...	+	+	...	...	+					
149	*Lepralia japonica*, Busk	...	...	...	...	+	...	...	+	+	+	...	...	Mauritius, Trincomalee.
150	,, *cucullata*, Busk	+	+	...	+	+	+	+	+	...	...	...	+	California, S. Africa.
152	,, *robusta*, Hincks	...	...	...	...	+	...	...	+	...	...	...	...	Mergui.
152	,, *occlusa*, Busk	...	...	...	...	+	...	...	...	+	...	+	...	Crozet Is.
156	*Smittia spathulata*, MacG.	...	...	...	...	+	+	...	+	...	...	+		
157	,, *marmorea*, Hincks	...	+	+	+	+	...	...	...	...	...	...	+	
157	,, *egyptiaca*, nov.													
158	,, ,, var. *heroopolita*,	...	...	...	...	+	+							
	nov.	...	...	...	...	+								
158	*Rhynchozoon corrugatum*, Thorn.	...	...	...	...	+	...	...	+					
159	*Lagenipora Costazii*, Aud., var. *spathulata*, MacG.	...	...	...	...	+	...	...	...	...	...	+		
161	*Holoporella aperta*, Hincks	...	+	...	...	+	+	+	+	+	...	...	...	Cuba.
162	,, *Decostilsii*, Aud.	...	...	...	...	+	+							
163	,, *pigmentaria*, nov.	...	...	...	...	+	+							
164	,, *vermiformis*, nov.	...	...	...	...	+								

Collected by Hartmeyer, Siemens & Löffler.

Page		Cape Verde I.	Atlantic.	British Isles.	Mediterranean.	Red Sea, Cross.	Red Sea, Hart.	Indian Ocean.	Ceylon.	Zanzibar.	Japan.	Australasian.	Fossil.
165	*Canda arachnoides*, Lamx. (1)	...	...	...	...	...	+	...	...	...	+w.	+	
166	*Scrupocellaria cervicornis*, Busk	...	+	...	...	...	+	+	+	+	...	+	
166	*Membranipora trifolium*, var. *minor*, Hincks	...	+s.	...	...	...	+	...	...	...	...	+	+
167	,, *Aragoi*, Aud.	...	...	...	...	...	+						
167	*Farcimia oculata*, Busk	...	+	...	...	...	+	+	+	+	...	+	+
168	*Chaperia tropica*, sp. nov.	...	...	...	...	...	+						
168	*Microporella Malusii*, Aud. (2)	...	+	+	+	...	+	+	...	...	...	+	+
168	*Schizoporella nivea*, Busk (3)	...	...	...	...	...	+	+	+	+	...	+	
169	,, *mucronata*, Sm.	...	+	...	...	...	+	...	...	...	...	+	
169	,, *pes anseris*, Sm. (4)	...	+	...	...	...	+	...	+				
169	,, *Bernardii*, Aud. (5)	...	...	...	...	...	+	...	+				
170	*Gigantopora fenestrata*, Sm. (6)	+	+	...	...	...	+	...	+	...	...	...	+
171	*Lepralia Montferrandi*, Aud.	...	...	...	...	...	+	+	+	...	+		
171	,, *lonchæa*, Busk	...	...	...	...	...	+	...	...	...	...	+	
172	,, sp.												
172	*Lagenipora ? tuberculata*, MacG.	...	...	...	...	...	+	...	...	...	...	+	
173	*Smittia nitida*, Verrill	...	+	...	...	...	+						
173	,, *trispinosa*, var. *protecta*, Thorn.	...	...	...	...	...	+	...	+				
174	,, *tropica*, sp. nov.	...	...	...	...	...	+						
174	*Lagenipora Costazii*, Aud.	...	+	+	+	...	+	...	...	...	...	...	+
175	*Retepora hirsuta*, Busk	...	...	...	...	...	+	...	...	...	...	+	
176	,, *abyssinica*, nov.	...	...	...	...	...	+						
176	,, *jermanensis*, nov.	...	...	...	...	...	+						

Other Localities :—

(1) Timor.

(2) Tahiti, S. America, S. Africa. Fossil: Tert., Europe, Australia, Patagonia.

(3) S. Africa.

(4) Mauritius.

(5) Lifu.

(6) S. Africa, Mauritius, Brazil.

Known in the Red Sea from other Collections.

	Cape Verde I.	Atlantic.	British Isles.	Mediterranean.	RED SEA.	Indian Ocean.	Ceylon.	Zanzibar.	Japan.	Australia.	Fossil.	
(2) *Membranipora bellula*, Hincks	+	...	...	...	+	...	...	...	...	+	...	Madagascar.
(1) *Micropora coriacea*, Esper	...	+	+	+	+	...	...	...	...	...	+	Mauritius.
(2) *Thairopora mamillaris*, Lamx.	...	...	...	...	+A.	W. co	ll.	+	...	+		
(1) *Microporella impressa*, Aud.	...	...	+	+	+							
(1) ,, *personata*, Busk	...	...	...	...	+	+	...	...	+	...	...	Falkland I.
Cribrilina radiata, Moll.	...	+	+	+	+	+	...	+	...	+	+	Tahiti, Singapore or Philippines.
(1) ,, *Gattyæ*, Busk	...	...	+	+	+							
Schizoporella Dutertrei, Aud.	...	+	+	...	+	...	...	...	...	...	+	
(4) ,, *Leperei*, Aud.	...	...	...	...	+							
(1) *Schizotheca serratimargo*, Hincks	...	...	...	+	+	...	...	...	...	...	+	Suez.
(1) *Lepralia Pallasiana*, Moll.	...	+	+	+	+	...	...	...	...	...	+	
(3) ,, *quadrata*, MacG.	...	...	...	...	+	+ (1)	...	...	...	+	+	Tizard Reef.
(4) ,, *Marceli*, Aud.	...	...	...	...	+							
(1) *Smittia ophidiana*, Waters	...	...	...	+	+	...	...	...	...	...	+	
(1) *Retepora fissilabris*, Busk, MSS.	...	...	...	...	+							
(5) ,, ? *prætenuis*, Hincks	...	...	...	...	+							
(5) ,, ? *plana*, Hincks	...	...	...	...	+							
(5) ,, *cellulosa*, Hincks	...	+	...	...	+	...	...	...	...	...	+	
Holoporella pertusa, Sm.	...	...	...	...	+A.	W. co	ll.					

(1) British Museum.
(2) This was taken from a sounding-line on a passenger ship in the Red Sea. There is the off-chance that it may have adhered to the line from other soundings.
(3) Named *robusta* in Brit. Mus. (4) Audouin, 'Description de l'Égypte.'
(5) Hincks, Ann. Mag. Nat. Hist. ser. 5, i. (1878) p. 356–364.

should cause us to carefully examine other characters to make sure that our classification is correct. Unless the material is very limited or difficult to cut, the tentacles of many zoœcia can be counted.

In some cases, such as the Cyclostomata, most Ctenostomata and a few Cheilostomata, where the number of tentacles is small, namely 8–12, large pieces may be examined without finding any variation, whereas where there are more tentacles then there is a greater range; but even then there is one number which is far the most abundant, and from this there may be a variation of one or two on each side, but never a large range. I usually say

about so many, and it must be understood that absolute uniformity is not usually intended. I have the figures of a large number of species besides those published, and hope to discuss the results.

Jullien and Calvet's terms 'anter' and 'poster' are now adopted. Jullien & Calvet, 'Bry. prov. de l'Hirondelle,' p. 17, 1903, divide the aperture into 'anter' and 'poster,' and the operculum into 'porta' and 'vanna.' The anter is the distal part of the aperture and is closed by the porta; and the poster is the proximal part and is closed by the vanna. The division is made by an imaginary line between the two points at which the operculum is hinged. According to Jullien the vanna closes the opening of the compensation sac, but for his explanation and the function of the two parts the reader is referred to the work mentioned.

ÆTEA RECTA, *Hincks.*

Ætea recta, Hincks, Ann. Mag. Nat. Hist. ser. 3, vol. ix. p. 25, pl. 7*. fig. 3; Waters, "Chatham Island, &c.," *op. cit.* ser. 7, vol. xvii. p. 12, pl. 1. fig. 13. For other synonyms see Miss Jelly's Catalogue.

This is probably the most widely distributed species of *Ætea* and has often been mentioned under other names. The specimens in this collection are small and do not permit of further study. This is the species in which the ovicells are known *.

Loc. Khor Shinab (3), Khor Dongola (2) (19).

SYNNOTUM AVICULARE (*Pieper*).

Gemellaria avicularis, Pieper, Jahresbericht Westfälischen Provincialvereins, vol. ix. p. 43, pl. 2. figs. 5–9 (1880).

Notamia avicularis, Waters, "On the Use of the Avicularian Mandible, &c.," Journ. R. Micro. Soc. ser. 2, vol. v. p. 6 (1885).

Synnotum aviculare, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xvii. (1886) p. 257; Kirkpatrick, "Zool. of Fernando Noronha," Journ. Linn. Soc., Zool. vol. xx. (1888) p. 504; Waters, Journ. Linn. Soc., Zool. vol. xxvi. (1896) p. 14, pl. 1. figs. 6, 7; ? Robertson, "Non-incrusting Chil. Bry.," University of California, Zool. vol. ii. no. 5, p. 286, pl. 14. figs. 84, 85 (1905); Thornely, Rec. Indian Mus. vol. i. pt. 3, no. 13, p. 183 (1907).

? *Gemellaria ægyptiaca,* Savigny (name on plate), pl. 13. fig. 4, but *Loricaria ægyptiaca,* Audouin, "Descrip. de l'Égypte," in text, p. 234.

Loc. Although this has for the most part only been seen in small fragments, its distribution is extremely wide, as it has been found from Naples, Rapallo, Trieste, Andamans (*Th.*), Tizard Island, Portland and Port Phillip (Victoria), S. Africa, Fernando Noronha, California (?). Khor Shinab, 10–12 fath. (3), Nersa Mukdah (12), Khor Dongola (19), collected by Crossland; lat. 15° N., long. 41° W., 18 fath., collected by Löffler & Siemens; Ras el Millan, collected by Hartmeyer. The specimens so named from California

* Waters, Journ. Linn. Soc., Zool. vol. xxvi. (1896) p. 5.

are somewhat larger, and from Zanzibar there is a larger form which I believe to be a new species.

VITTATICELLA CONTEI (*Audouin*). (Plate **10.** figs. 1–4.)

Eucratea Contei, Audouin, "Descr. de l'Égypte," Hist. nat. p. 242; Savigny, on plate 13. fig. 1, calls it "Catenaires" *.
Catenicella Savignyi, Blainville, Man. d'Actinologie, p. 462, pl. 78. fig. 5 (1834).
Catenicella Contei, d'Orb. Pal. Franç. vol. v. p. 44 (1850).

The zoarium has usually one or two single globulæ, and then a geminate one, and a new branch may also occasionally grow with a corneous connection from the anterior surface of a globula. There are radicles from the dorsal surface, though frequently radicle chambers exist without the radicles being developed. Neither the growing stolons nor the earliest zoœcia have been found. Zoœcia elongate, contracting to the base, with a narrow vitta on each side; a spinous process, varying considerably in length, at each upper corner; but apparently without avicularia, and in stained preparations these processes were found to be empty.

The oral aperture is nearly round, but rather flattened on the proximal edge; the operculum is smaller than in any other species of *Catenicellidæ* which I have examined, and the muscular attachments are at the side. The compensation sac is very short.

There are 12 tentacles. According to Maplestone there are also 12 tentacles in *C. lorica*, Busk, and *C. ventricosa*, Busk. The ovicells are unknown.

The species was first figured by Savigny, who placed it in his genus *Catenaria*, which apparently included this and *Alysidium Lafontii* (Aud.), but Audouin in his description called them both *Eucratea*; next Blainville modified the name *Catenaria* to *Catenicella*, for which verbal change there was no justification, and *Contei* was the type which he again figured, but his genus included *Hippothoa divaricata*, from which part of his generic description was written, in fact he says perhaps *Contei* is the same as *H. divaricata*, Lamx. It will thus be seen that the genus *Catenicella* should never have been made, and that it is a synonym of *Catenaria*; nor was Blainville justified in changing the specific name and calling the species *Savignyi*. Several of Audouin's species were similarly re-named by d'Orbigny.

For this division of the *Catenicellidæ* MacGillivray has made a new

* It may be well to call attention to the fact that Savigny always used the plural form of the generic name on his plates, even when there was only one species. On the present plate (13) there are the names of three genera, while there are only four species, so that we can only presume which species Savigny meant to join together, and apparently Audouin was in the same position as we are. Audouin placed the first three species in one genus, but now they are put in three.

genus *Caloporella* *, afterwards changed to *Vittaticella*, thus unfortunately removing the type of *Catenaria*—or, as generally known, *Catenicella*—from the genus *Catenicella*. However, it would now cause great confusion to change the name of *Catenicella*, especially as *Catenaria* has been differently defined.

Loc. Mediterranean (*Blainville*) ; Red Sea and Java (*d'Orbigny*). Among coral from a reef, Khor Dongola (19) ; and Nersa Makdah, 5 fath. (12), collected by Crossland.

CATENARIA LAFONTII (*Audouin & Savigny*).

For synonyms see Miss Jelly's Catalogue under *Eucratea Lafontii*, and add :—

Catenaria Lafontii, Harmer, "Morph. Cheil.," Q. Journ. Micr. Sc. vol. xlvi. (1902) p. 305, pl. 17. fig. 49; Thornely, "Manaar," p. 108 (1905); id. Records of Indian Museum, vol. i. p. 3, no. 13 (1907) p. 180.

Eucratea Lafontii, Calvet, "Bry. Mar. de Cette," Tr. Inst. de Zool. de l'Univ. de Montpellier, 2nd ser. Mém. 11, p. 13 (1902); "Bry. Mar. de Corse," *op. cit.* Mém. 12, p. 6 (1902).

It is very difficult to decide what the generic name should be, as one author after another has made a series of mistakes about the genus.

It was figured by Savigny, and the generic name on the plate was presumably *Catenaires*, as we must certainly conclude that it was meant to refer to *C. Contei*, Aud., and *C. Lafontii*; but *C. Contei* was figure 1, and therefore should be the type. Now this is typical *Catenicellidæ*, though for this species (*Contei*) Blainville modified the name to *Catenicella*, which according to our present ideas was quite unallowable, and what we now call *Catenicella* should have been *Catenaria*. In the text Audouin placed *Lafontii* under *Eucratea*, and this seemed right at the time, but as the branching is very different, and the ovicells do not at all correspond, it now seems advisable to retain the two genera.

Then Busk made a new genus *Alysidium* for it, but later in the 'Challenger' Report he took *Lafontii* as the type of *Catenaria*, though, as we have seen, *Contei* should have been the type. D'Orbigny had, however, described the genus *Catenaria*, so that if it is retained it is *Catenaria* of d'Orbigny ; we have here, however, the difficulty that he placed in it *C. Lafontii*, *C. chelata*, Lamx., and *C. ambigua*, d'Orb., whereas he ought to have retained *Eucratea* if *chelata* is included.

Busk described several new species as *Catenaria*, and Harmer and Thornely have followed him in placing *Lafontii* under *Catenaria*; and though it certainly never ought to have been placed under *Catenaria* it seems to be best to leave it here.

The ovicell of *Catenaria diaphana*, Busk, is somewhat similar and the thrown-back open ovicell must be considered as a generic character.

* The name was subsequently changed by MacGillivray, as there was already a genus *Calloporella*, see Proc. Roy. Soc. Vict. n. s. vol. xiii. p. 210 (1901).

There are about 15–17 tentacles, and the ovicell is not closed by the operculum.

Although there is a considerable amount of material, it has not been possible to find the stolon from which it grows, or the younger zoœcia, and it had all evidently been torn away from the surface on which it grew. As I have already stated, *Alysidium parasiticum*, Busk, is rooted by corneous tubes, which sometimes have calcareous nodes from which the stalk of the sub-colony grows, but I consider that *A. parasiticum* must be placed under *Eucratea*.

The North Italian fossil *Unicrisia tenerrima*, Reuss, belongs to the genus *Catenaria* *.

Loc. Adriatic; Naples; Capri; Rapallo; Cette, 70–80 met. (*Calv.*); Corsica, 35 met.: Maderia; Manaar (*Th.*); Andamans (*Th.*). Khor Shinab, 10–12 fath. (3); from Mediterranean ship docked in Suez (9); Nersa Makdah (12); Floating Stage, Suez (15), Khor Dongola (19), Suakim; Wasin, Brit. E. Africa, 10 fath. (501); Ras Osowamembe, Zanzibar Channel, 10 fath. (504); Prison Island, Zanzibar, 8 fath. (505); Chuaka, Zanzibar (508), —all collected by Crossland.

SCRUPOCELLARIA JOLLOISII (*Savigny & Audouin*). (Plate **10.** figs. 5–10.)

Acarmarchis Jolloisii, Aud. "Description de l'Égypte," Hist. nat. p. 240; Savigny, pl. 11. fig. 2 (on plate "Cellaires").

Zoarium large (over 30 mm.), spreading out in fan-shape; many zoœcia in an internode (17 counted in one case). Zoœcia with large, wide, nearly round area, having a small spine at each upper corner, and one stout one, representing a scutum, across the middle of the area; along the median line of the zoarium a small triangular avicularium to each zoœcium, pointing downwards. The ovicells are wide, with large perforations over the surface and a thickened band at the proximal edge.

On the dorsal surface the divisions between the zoœcia are very wide, as figured by Savigny, and there is a large vibracular chamber near the proximal end of the zoœcium, with a radicle chamber below the vibracular chamber. The vibracular setæ are about the length of two or three zoœcia, and are smooth, recurved at the end. There is one vibraculum at a bifurcation. The radicles are large smooth tubes, often connected to the other branches as in *Canda arachnoides*, Lamx.

There are vermiform bodies at the side of the zoœcium (fig. 10), extending to the proximal end, but starting from the fleshy mass at the distal end. In one case there are oval masses in the vermiform body which show ridges, but this may be a postmortem change. The whole organ must be compared with the bodies I described † in *Bugula bicornis*, Busk, though

* Waters, Quart. Journ. Geol. Soc. vol. xlviii. (1891) p. 5, pl. 1. fig. 11.

† Résultats du Voy. du S.Y. 'Belgica,' Bryozoa, p. 21, pl. 1. fig. 4 (1904).

the histological structure is not quite the same (fig. 10). There are about 16 tentacles.

Loc. Suez, "among coral," collected by Crossland; Ras el Millan, collected by Hartmeyer.

SCRUPOCELLARIA BERTHOLLETII (*Audouin*).

Scrupocellaria Bertholletii, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xvii. (1886) p. 258, pl. 9. figs. 1, 2.

Acamarchis Bertholleti, Audouin, "Descrip. de l'Égypte," Hist. nat. vol. i. p. 241, pl. 11. fig. 3. The plate is marked *Cellaires*.

Cellularia gracilis, d'Orb. Pal. Franç. vol. v. p. 50 (1850).

Scrupocellaria capreolus, Heller, "Bry. Adriat.," Verh. k.k. zool.-bot. Gesellsch. Wien, vol. xvii. p. 87, pl. 1. fig. 1 (1867).

Cellularia capreolus, Ostroumoff, "Étude Zool. et Morph. de Bry." Arch. Slaves de Biol. p. 565, pl. 2. figs. 23–26. This is the translation of a Russian paper, 1886.

Scrupocellaria reptans var. *Bertholletii*, Waters, "Bry. from Rapallo," Journ. Linn. Soc., Zool. vol. xxvi. (1896) p. 6, pl. 1. figs. 18, 19.

I have already shown how the characters correspond with those of *S. reptans*, L., in which, however, the scutum is usually more developed, though in these two forms we seem to have a pretty complete range from zoœcia without a scutum to those with a broad scutum protecting the whole area. It is, however, perhaps more convenient to retain the specific name of *Bertholletii*.

Loc. Naples, Capri, Rapallo, Trieste, Cape Verde Islands, Suez (9), and underside of buoy (14), collected by Crossland.

SCRUPOCELLARIA SERRATA, sp. nov. (Plate **10**. figs. 11–14.)

Zoarium with narrow branches, and short internodes having 5–8 zoœcia. Zoœcia long and narrow, area about half the length of the zoœcium, with two outer spines and one inner; the scutum is delicate and cervicorn, ranging, however, from the simple spine to the multi-cervicorn forms as in *S. Bertholletii*, Aud. There are no median, and to most zoœcia no lateral avicularia, nor are there any vibracula; however, to some zoœcia standing out from the side just below the ovicell there is a large avicularium (fig. 11), and these have long narrow mandibles, which are bifurcate or trifurcate at the end, with spinous processes at the side (fig. 14). Some pieces have no avicularia. *S. varians*, Hincks, and *S. obtecta*, Haswell, also have a large lateral avicularium. The radicle is attached to a chamber close to the base of the zoœcium and is thin and serrate. Busk mentions the radicles of *S. Macandrei*, Busk, and *S. ferox*, Busk, as being serrate. The globular ovicells are perforated. There are 14 tentacles.

This species has the habit and many of the characters of *S. Bertholletii*, Aud., but differs from it in having, as a rule, no avicularia and no vibracula.

Loc. Suez, about 5 fath., collected by Crossland.

SCRUPOCELLARIA MANSUETA, sp. nov. (Plate **10**. fig. 15.)

Zoaria widely expanding, usually 8 zoœcia to an internode. Zoœcia with large area about two-thirds of its length, wider at the distal end and without spines. There is no scutum, though in a few zoœcia I have found a stout spine exactly corresponding with that of *S. Jolloisii*, Aud., and in each case the spine occurred on the zoœcium just below the bifurcation and on the left side. The small median avicularia are directed diagonally downwards, there is a small lateral avicularium, and on the dorsal surface a vibraculum by the side of the proximal end of the zoœcium, while at the bifurcation there is one vibraculnm. The ovicell is widely open and perforate.

S. mansueta differs from *S. Jolloisii* in not usually having oral spines or a stout spine over the area, but the occasional occurrence of this spine confirms the relationship; also in most characters there is a great similarity to *S. ferox*, Busk, in which, however, the median avicularia are much larger.

The name is given from the unarmed character of the species, in comparison with *S. Jolloisii*, Aud. There is a somewhat similar though more delicate form from Zanzibar in which there are three external and one internal spine.

Loc. Suez, on sponge from underside of a buoy (23), collected by Crossland; Ras el Millan, collected by Hartmeyer.

SCRUPOCELLARIA SCRUPEA, *Busk*, var. DONGOLENSIS, nov.

Scrupocellaria scrupea, Thornely, "Manaar," p. 109.

There is a very stout penduncle to the scutum; and close to the base of the peduncle, but on the zoœcium next laterally, there is a very minute avicularium; the lateral avicularia are very large, and the vibracular chamber extends diagonally nearly to the median line of the zoarium. The setæ are smooth, and shorter than a zoœcium. The radicles are wide, long, and as a rule smooth, but occasionally they are toothed at the end only. The ovicell is smooth, imperforate, and the operculum is entirely separable, as we have seen in *Caberea Boryii*, Aud., and *C. Darwinii*, Busk. There are two spines on the outer border and one on the inner, and there are two vibracula at a bifurcation, as in *C. Delilii*, Aud., to which it is closely allied. The northern form *S. scabra* has only one vibraculum at a bifurcation.

S. scrupea, Busk, *S. Macandrei*, Busk, *S. Delilii*, Aud., *S. scabra*, Van Ben., seem to form a closely allied group; and from what I have seen of specimens from the East, I am inclined to believe that this variety is what has frequently been called *scrupea* from the Indian and China Seas. There are 13 tentacles: in *S. scabra*, Van Ben., there are 16; in *S. Smittii*, Norm., 15; in *S. serrata*, Waters, 15; in *S. reptans*, L., 14–16 (Hincks); *S. Jolloisii*, Aud., 16.

Loc. Naples (one specimen in A. W. coll.); Trincomalee (B. Mus. coll.).

Khor Dongola, among corals on a reef (19); Beacon Island (6) and Engineer Island, Khor Dongola, collected by Crossland. Manaar.

Bicellaria ciliata (*Linnæus*).

For synonyms see Miss Jelly's Catalogue and add Levinsen, "Mosdyr," Zool. Danica, p. 46, pl. 1. figs. 32–35.

The specimens from the Sudan have both the zoœcia and the area somewhat smaller than those of my Naples or British specimens.

Nitsche * describes the ovicell of this species, which is very curious in being pedunculate; but not all species of *Bicellaria* have pedunculated ovicells, as, for instance, *B. tuba* and *B. grandis*, in which they are terminal. Again, in the group of *Bugula neritina* the ovicell is pedunculate, but it is not a general character in *Bugula*, and the same is the case in *Stirparia*, where some only have a pedunculated ovicell. This shows how careful we must be in the use of one character, for at first sight we should expect such a divergent form of ovicell to be of at least generic value. This question is also referred to under *Bugula neritina*.

Loc. Northern, British, Mediterranean, Australian, S. Africa; Khor Dongola, Red Sea (19), on coral-reef, collected by Crossland.

Bugula avicularia (*Linnæus*).

This species occurs from the Arctic; Northern Seas; Mediterranean; Charlotte Island; N.E. coast of America; Australia. Suez, from Mediterranean ship 'Thyra' (9); from buoy at entrance to canal, Suez (14); Nerskah Makdah, 5 fath. (12), collected by Crossland.

Bugula neritina (*Linnæus*). (Plate **11**. figs. 1–3.)

For synonyms see Miss Jelly's Catalogue and add:—

Acamarchis neritina, Aud. "Descrip. de l'Égypte," Hist. nat. vol. i. p. 240, pl. 11. fig. 1.

Bugula neritina, Calvet, "Bry. Mar. de Cette," p. 21; Thornely, "Manaar," p. 109, (?) Rec. Indian Mus. p. 183 (these last two are probably var. *minima*); Philipps, Polyzoa from Loyalty Island, p. 443; Robertson, Non-Incrusting Bry. p. 266, pl. 9. fig. 47, pl. 16. fig. 97.

Acamarchis prismatica, Gray, Dieffenbach's New Zealand, vol. ii. p. 292.

The ovicell of *Bugula neritina* has usually been unsatisfactorily figured and imperfectly understood, but Nitsche † has given a description and figure of the ovicell of *Bicellaria ciliata*, L., and the two are very similar. The ovicell of *B. neritina* is pedunculate and attached at the inner upper corner of the zoœcium. A fleshy mass grows out laterally from the inner side of the zoœcium near to the distal end, but not close up to it; this gradually becomes larger, and then below it a minute portion of calcareous shell commences to

* Zeitsch. für wissensch. Zool. xx. p. 4 (1869).

† Tom. cit. p. 3.

grow and ultimately surrounds the ovicell (fig. 1). The mature ovicell is always directed laterally.

A similar lateral pedunculate ovicell occurs in *Bicellaria ciliata* (L.); *B. uniserialis*, Hincks; *Stirparia ciliata*, Robertson; *S. occidentalis*, Rob.; *S. californica*, Rob.; *S.* sp. 1, MS.; *S.* sp. 2, MS.; *S.* sp. 3, MS., Zanzibar.

There are two or three forms with avicularia which may have to be called varieties of *neritina*, but all have similar ovicells, among them is *B. robusta*, MacG.*. *Bugula calathus*, Norm., *B. dentata*, Lamx., *B. ditrupa*, Busk, *B. avicularia*, L., *B. Sabatieri*, Calvet, *B. Murrayana*, Johnst., *B. cucullata*, Verrill, all have ovicells central—that is, attached by their whole width, commencing in the same way by a small projection over which the calcareous wall ultimately grows. Now all these species are so similar to *B. neritina* in most characters and in the avicularia, that we feel satisfied they all must remain in the same genus, in spite of the very marked difference in the ovicell. We have the lateral pedunculate form of ovicell in some *Bicellaria* and apparently in all *Stirparia* (a genus, in my opinion, most closely allied to *Bicellaria*, though not so closely to *Bugula*); on the other hand, in *Bicellaria tuba*, Busk, and other species of *Bicellaria* the ovicell is central and attached the whole width.

The ovicells must be a most important character in classification, but finding the same two distinct forms occurring both in *Bugula* and in *Bicellaria* is a warning as to the care that must be exercised in using the ovicells or indeed any one character too exclusively.

Loc. Atlantic, Mediterannean, Indian Ocean, Ceylon, (?) Australia, Loyalty Island, Rio de Janeiro, California; Honduras (*B. M.*). Suez Bay, 10 fath. (10); Canal entrance, on buoy (14); Floating Stage (15); Suez (9, 13, 16, 20); Khor Shinab, 10–12 fath. (3), collected by Crossland.

BUGULA NERITINA, var. MINIMA, nov. (Plate **11**. figs. 4–7.)

Bugula neritina, Waters, "Australian Bry.," Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 91, pl. 4. figs. 3 & 15; and probably Thornely, "Manaar," p. 109, Rec. Indian Mus. p. 183.

There are forms from the Red Sea in which the colour is much lighter than in *B. neritina* typica, but there are similar light brown linear pigment cells, both zoaria and zoœcia are more delicate; the zoœcia are shorter, being about 0·65 mm. long, while the type is usually about 1·1 mm. There are, however, considerable variations in size; also in *B. avicularia* there is material variation in the colonies, and even in one colony I measured zoœcia 0·55 long and others 1·1 mm. long. There are only about 6 zoœcia from one bifurcation to the next in the var. *minima*, whereas the branches of the type are longer, having about 10 zoœcia. The specimen from Ball's Head, New

* *B. robusta*, MacG., occurs in S. Africa as well as in Australia.

South Wales, is stouter than the Red Sea one, but I think it must be placed with *minima* and perhaps shows us a link to *B. robusta* *.

There is in *minima* a long beaked avicularium, growing from a tubular basis, close to the proximal end of the zoœcium; and here, again, there is variation in size, as those nearer the extremity are the longest and largest. Very stout radicles grow from the middle of the dorsal surface.

The globular ovicell is attached to the side of the zoœcium and opens laterally, just as in the ordinary *B. neritina*, L.; *B. robusta*, MacG., has similar lateral ovicells, but the avicularia are nearly globular, while *B. cucullata*, Busk, has the avicularia somewhat higher and the ovicell terminal. Most of the *Bugulæ* have the avicularia attached near the distal end, but in this variety, in *B. robusta*, MacG., and in *B. cucullata*, Busk, they are near to the proximal end. In the Zanzibar specimens there are two or three clear spots on the dorsal surface, at the outer upper corner of the zoœcium. The specimen from Khor Dongola have somewhat smaller zoœcia and much smaller avicularia than those from Nersa Makdah.

Loc. Ball's Head, N. S. Wales (*W.*). Prison Island, Zanzibar Channel, 8 fath., on *Meleagrina margaritifera*; Khor Dongola (2); Nersa Makdah, 5 fath., on stem of antipatharian (12); Agig Suraya (21),—collected by Crossland.

Other tropical species of *Bugula* are *B. dentata*, Lamx.; *B. mirabilis*, Busk; *B. versicolor*, Busk; *B. reticulata*, var. *unicornis*, Busk.

Beania intermedia (*Hincks*).

Diachoris intermedia, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. viii. (1881) p. 74, pl. 5. fig. 8; Thornely, Rec. Indian Mus. vol. i. pt. 3, no. 13 (1907) p. 184.

Beania intermedia, MacG. Zool. Vict. dec. xx. (1890) p. 346, pl. 195. fig. 3; Waters, Ann. Mag. Nat. Hist. ser. 7, vol. xvii. (1906) p. 15, pl. 1. figs. 16–18.

In the specimen from the Canal entrance, Red Sea, the spinous processes on each side, described by Hincks, are absent, whereas in the Chatham Island specimens they sometimes occur, but much lower than figured by Hincks, and very small. In the specimen that I figured there were none.

Loc. Tasmania (*Hincks*); Victoria (*McG.*), Napier and Wellington (*Hamilton*), Chatham Island (*Waters*). Lat. 6° 6′ 30″ N., long. 81° 23′ E., 32 fath., and off Ganjam Coast, 35 fath. (*Thornely*). Suez Canal entrance, also one zoœcium on *Amathia* from s.s. 'Thyra' docked at Suez (9), collected by Crossland.

Membranipora Savartii (*Audouin*). (Plate **11**. figs. 8–13.)

Flustra Savartii, Aud. "Zool. d'Égypte," p. 240, pl. 10. fig. 10.

Membranipora Savartii, Busk, Crag Polyzoa, p. 31, pl. 2. fig. 6 (1859).

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* Busk gave the name *capensis*, MS., to a S. African species, but from specimens in my collection, one of which was named by Busk, this is *B. robusta*, MacG.

Biflustra Savartii, Smitt, Floridan Bryozoa, pt. ii. p. 20, pl. 4. figs. 92–95 (1873); Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 67, pl. 14. fig. 2; Manzoni, "Castrocaro," p. 38, pl. 2. fig. 17 (1875).

Biflustra delicatula, Busk, Crag Polyzoa, p. 72, pl. 2. fig. 7 (1859); Manzoni, Bry. Plioc. Ital. 2nd cont. p. 4, pl. 1. fig. 5 (1869); MacGillivray, Zool. Vict. dec. vi. p. 28, pl. 57. fig. 2. (1881).

There has been much uncertainty concerning this species and its range; for *Membraniporæ* have been obtained from many places, only differing, firstly, in the absence of the two small tubercles shown by Savigny, and, secondly, some have a broad serrate denticle at the proximal end of the opesia.

The specimens from Suakim (7) have neither tubercle nor serrate denticle, whereas a small incrusting specimen on *Retepora* from the Red Sea, lat. 16° N., long. 41° W., 30 fath., collected by Siemens & Löffler, has the serrate denticle directed inwards towards the basal wall (fig. 13). In the specimens from Suakim Harbour the zoarium is at first loosely incrusting, and from this adnate growth arise erect cylindrical or compressed branches dividing dichotomously (fig. 10).

In these there is a row of communication plates across the distal wall about halfway between the front and the base; sometimes the row is double or irregular, with a tendency to form two groups. In a specimen of *Membranipora* from Penang, which has large tubercles and a narrow brown line surrounding the zoœcia as described by Busk for *M. denticulata*, the two distal rosette-plates are near the base in the corner. This must probably be separated from *Savartii*.

The specimens from Suakim are fragile and have not a great amount of calcareous matter, and there are no denticles either in the adnate portion or in the branches, though in specimens from Khor Dongola (4) there are no denticles in the younger portion, while they occur in the older branching parts; but in neither case are they found in the adnate basal cells. MacGillivray * says, when speaking of *M. delicatula*, "the serrated denticle at the bottom of the aperture exists only in two or three cells of the Queenscliff specimen and is altogether absent in those from Queensland"; and Busk, in describing *M. denticulata*, says "one or two rounded or triangular eminences (probably ovicells) are visible on many of the cells in front and below." The tubercles are not described from the Crag, nor were they found by Smitt, but tubercles in this group are very variable; and I therefore follow other workers in placing under *Savartii*, Aud., species with and without tubercles. The simplest forms of the group have no tubercles, no serrate denticle, and the communication pores are more or less in a line, whereas in others the line is broken up into two groups. There are normally four lateral rosette-plates.

A specimen from Zanzibar has proximal narrow cervicorn denticles, and another from Zanzibar contains an astonishing amount of the parenchym

* Prod. Zool. Vict. dec. vi. p. 28.

threads which often form quite thick cords, seen, however, to be formed of finer threads. Granular masses, which stain, are sometimes included in these cords.

There are 15 tentacles, and I have seen no intertentacular organs.

Loc. Florida ; Victoria ; Queensland ; Ceylon ; Indian Ocean ; Zanzibar ; Khor Shinab (3), Khor Dongola, 9½ fath. (4), Suakim, 5 fath. (7, 8), Suez Docks (20), collected by Crossland ; lat. 16° N., long. 41° W., 30 fath., and Gimsah Bay, collected by Loffler & Siemens. It is also found fossil in the Crag and the Tertiaries of Europe, Australia, and Egypt, and probably some Cretaceous fossils known under other names should be placed here, but the discussion of the fossils is postponed to a future occasion.

MEMBRANIPORA ? BURSARIA (*MacGillivray*). (Plate **12**. fig. 10.)

Amphiblestium bursarium, MacG. Trans. R. Soc. Vict. vol. xi. (1886) p. (3), pl. 2. fig. 2.
Siphonoporella bursaria, Thornely, "Manaar," p. 111.

Miss Thornely is right in placing this with the *Siphonoporella* of Hincks, though it is doubtful whether the genus can be retained. I have a specimen from West Australia sent to me as *Siphonoporella nodosa*, Hincks, and which I believed to be the co-type, though it does not correspond entirely with Hincks's figure and description, as it has a tubercle at each top corner of the zoœcium and it has a vicarious avicularium, broader and shorter than the one figured on my *M. bursaria*, var. *phillipensis* *. Hincks wrote "no avicularia," and in no specimens that I have seen are they frequent, being only found here and there. Hincks does not seem to have correctly appreciated what he called a siphon, for it is a tube † or neck through which the polypide is extended from the broader part of the zoœcium to the surface ; and in this group, instead of being central as in *Micropora*, *Steganoporella*, *Thalamoporella*, it is frequently entirely to one side, with a large hollow space on the other side. In *Micropora*, as shown by Jullien, these two hollow spaces, or opesiules, contain the muscles, which pass from the base up to the membrane covering the zoœcium, thus drawing the membrane down and acting as a compensation sac. Now in *Siphonoporella nodosa*, H., although usually lateral, we sometimes see a hollow on each side ; while, on the other hand, some specimens of *M. bursaria*, from Victoria, only occasionally show the lateral position, so that it may be readily overlooked.

The Red Sea specimen, although in spirit, must have been long dead when collected, and I have been unsuccessful in obtaining any material for studying the opesial muscles ; however, the operculum is Membraniporidan, and we seem here to be able to follow the changes from such a form as *M. Rosselii* up to irregular *Siphonoporella* of Hincks. *Siphonoporella* and *Thairopora*

* Journ. Linn. Soc., Zool. vol. xxvi. (1898) p. 690, pl. 49. fig. 11.

† See Waters, "On Australian Bry.," Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 186 & fig. *a*.

are surely synonyms, of which *Thairopora* is the more satisfactorily diagnosed. Harmer, in his "Revision of the Genus *Steganoporella*," refers to the structure of *Siphonoporella* *.

Loc. Victoria, Ceylon; Engineer Island, Khor Dongola, collected by Crossland.

MEMBRANIPORA LIMOSA, sp. nov. (Plate **12.** figs. 1–5.)

The zoarium attains to at least 80 mm. in length, and is formed of long, quadrilateral, dichotomising branches; except for a short distance below the bifurcation there are four zooecia in a series; but where the branches divide the zoarium is hexagonal. It bifurcates at a rather narrow angle, about 40°, and in this respect corresponds with several species of *Farciminaria*. The zoarium is about 0·6 mm. in width, the horny walls are thick but contain a moderate layer of calcareous matter. At the bifurcation the walls of the zooecia become phenomenally thick, and in these thick-walled zooecia no polypides were found.

The zooecia are about 0·85 mm. in length, and the opesia about 0·6 mm. At the base of the opesial opening there is a small denticle, which often spreads out at the end. The denticle may easily be overlooked until preparations are made. No ovicells or avicularia have been found. There are numerous distal pores round the edge.

There are 15 tentacles, and sections do not reveal any intertentacular organ; but I have found it impossible to cut satisfactory sections of this species.

The zoarial growth is the same as that of *Farciminaria*, but the zooecia are so Membraniporidan and similar to the *M. Savartii* group, that it is placed under *Membranipora*. The ovicells of *Farciminaria* differ considerably from those of *Membranipora*.

The zooecia are much shorter than in any 'Challenger' *Farciminaria*, which vary from 1·26 mm. to 2·78 mm., while *F. Alice*, Jull. & Calv., is 2·36 to 2·55 mm. Busk calls *Farciminaria* an "emphatically abyssal" genus, although *F. brasiliensis* occurs from 32–400 fathoms. The *M. limosa* seems to be abundant, and is found from 10 fathoms in mud, from which cause the name is chosen. MacGillivray † says that the three Australian species of *Farciminaria* were dredged from a depth of 10–15 fathoms.

Busk, in his 'Challenger' Report, gives the genus *Farciminaria* as "submembranaceous or corneous," but all have a thin calcareous skeleton; even *F. uncinata* has thin calcareous walls, and the inner wall of the ovicell is entirely calcareous. *F. aculeata* and other species have a Membraniporidan

* Quart. Journ. Micros. Sci. vol. xliii. p. 232 &c.
† Prod. Zool. Vict. dec. xvi. p. 219.

operculum, and doubtless *Farciminaria* and *Membranipora* are closely allied. *Farciminaria magna*, B., has about 28 tentacles.

M. limosa is much like *Quadricellaria oblonga*, d'Orb., from the Chalk.

Loc. "Abundant in patches on the otherwise mud bottom of the Khuro," Khor Shinab, Red Sea, 10–12 fath. (3), and Khor Dongola, 20 fath., mud (2, 5), collected by Crossland.

THALAMOPORELLA ROZIERI (*Audouin*). (Plate **15**. figs. 12–15.)

Flustra Rozieri, Aud. Zool. Égypte, p. 239, pl. 8. fig. 9.

Thalamoporella Rozieri, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xix. p. 164; Waters, Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 186; Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. i. p. 75.

Reptescharellina Rozieri, d'Orb. Pal. Franç. vol. v. p. 453.

Membranipora Rozieri, Busk, Brit. Mus. Cat. ii. p. 59, pl. 65. fig. 6; MacGillivray, Monog. of Tert. Polyzoa of Victoria, p. 52, pl. 6. fig. 10 (1895).

Steginoporella Rozieri, Smitt, Floridan Bry. p. 16, pl. 4. fig. 102.

Steganoporella Rozieri, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vi. p. 379 (28).

Steganoporella Smittii, Hincks, Brit. Mar. Poly. p. 178, pl. 24. figs. 5, 6 (1880); Goldstein, Bry. from the Marion Island, Proc. Roy. Soc. Victoria, p. 7 note (1881).

Thalamoporella Smittii, Hincks, Journ. Linn. Soc., Zool. vol. xxi. (1887) p. 123; Thornely, Rec. Indian Mus. vol. i. pt. 3, no. 13, p. 187 (1907).

Steganoporella Rozieri form *indica*, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vi. p. 379 (29), pl. 16. fig. 1; Waters, Q. J. Geol. Soc. vol. xxxviii. (1882) p. 505, vol. xli. (1885) p. 292; Philipps, "Loyalty Island," p. 440 (1889); Thornely, "Manaar," p. 112 (1905).

The small tuberosity at the side of the aperture is very variable, and in specimens from Khor Dongola the knobs are sometimes developed, but not always, and are but small; again, in those from Rasel Millan they are occasionally seen where the walls meet, while in specimens from the Cape Verde Islands they are practically absent. Hincks created a variety *indica* for those forms without a tuberosity; but this form is general from the Cape Verde Islands, through the Red Sea, Manaar, to Australia, recent and fossil. The size of the zoœcia in all that I have seen is about the same. The ring-canal is very large, and the ovarian cells are surrounded by a coarse network. In the ovaria of most Bryozoa the ovarian cells are quite close together, and are surrounded by the follicle-cells, as figured by Vigelius * and others, but in some species these ovarian cells are partly surrounded by a coarse cellular network. This structure must probably be compared with what I have described in a species of *Alcyonidium* †.

There are 17–19 tentacles.

* Vigelius, W. I., "Die Bryozoen . . . . des Willem Barents," Bijdr. tot de Dierkunde, vol. xi. pl. iii. fig. 39 (1884).

† "Bryozoa from Franz Josef Land," Journ. Linn. Soc., Zool. vol. xxix. (1904) p. 180, pl. 20. figs. 8, 9, 10.

The ovicell has frequently been described as bilobate, though apparently the real structure has not been appreciated, for it really is a double ovicell in which there are two or more larvæ, and in the sections cut one is a little older than the other. In one specimen there is an ovicell containing three larvæ, and in another ovicell there is an indication of there having been three. There is no complete divisional wall in the ovicell.

On my specimens from Darnley Island, and in those described by Haswell from Holborn Island and Port Denison (Queensland), all of which form a tubular growth, no ovicells or avicularia have been seen, and without these organs it is impossible to feel absolutely certain of the determination. However, the zoœcia, in size and structure, are identical with those of *Th. Rozieri* from other localities.

Goldstein, *loc. cit.*, mentions it from Port Darwin as *S. Smittii*, and says that he has it "showing every stage from the ordinary encrusting form, through the free, erect, hemescharal and escharal forms."

Loc. Florida (*Sm.*) ; Britain (*H.*) ; Mediterranean, in Busk collection as *Steganoporella bifoveolata*, Heller ; Manaar (*Th.*) ; Palk Bay, Galle (*Th.*) ; Pedro Shoal (*Th.*) ; Lifu (*Ph.*) ; Darnley Island (*W.*) ; Holborn and Port Denison, Queensland (*Haswell*) ; Mauritius (*Kirkp.*) ; Rio de Janeiro (*B.*) ; Port Darwin (*Gold.*) ; West Australia (*Gold.*) ; Cape Verde Island (*Cross. Coll.*) ; Khor Dongola (19), Red Sea, collected by Crossland ; Gimsah Bay and Ras el Millan, collected by Hartmeyer.

Fossil. Bairnsdale, Gippsland (*W.*) ; River Murray Cliffs (*W.*) ; Victoria (*MacG.*).

TUBUCELLARIA CEREOIDES (*Pallas*).

This has been dealt with in my paper on *Tubucellaria*, Journ. Linn. Soc., Zool. vol. xxx. (1907) p. 126, pls. 15 & 16.

MICROPORELLA CORONATA (*Audouin*). (Plate **12**. figs. 6–9.)

Flustra coronata, Sav. & Aud. "Descr. de l'Égypte," p. 239, pl. 9. fig. 6.
Flustra umbracula, Sav. & Aud. *loc. cit.* p. 239, pl. 9. fig. 7.
Lepralia californica, Busk, Journ. Roy. Micr. Soc. vol. iv. p. 310, pl. 11. figs. 6, 7 (1856).
Lepralia lunifera, Haswell, "Polyzoa from Queensland Coast," Proc. Linn. Soc. New South Wales, vol. v. p. 40 (1881).
Lepralia ciliata, var., Waters, Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 188 (1887).

The mandibles are long, directed straight forwards as figured by Savigny. The ovicells are not large, granular, and sometimes umbonate. There are usually 4 spines, though sometimes 5 or even 6, and there are large pore-chambers, about 16 to a zoœcium. The mandibles have a projection on each side directed inwards, not far from the base.

Flustra umbracula as figured by Savigny is very similar, although a lip is shown in fig. 7_2, and the ovicells are large, but on fig. 7_4 not unduly so.

The *L. californica* of Busk is shown with the avicularia high up, and he says "above," which presumably means above the oral pore. Hincks shows the avicularia much lower down, and it is not clear that Hincks was describing the same species as Busk.

I only know *M. ciliata*, Pall., *M. coronata*, Aud., *M. impressa*, Aud., *M. Malusii*, Aud., *M. personata*, Busk, from the tropics. *M. coronata* belongs to the *ciliata* group, and it is a question whether it should be called a variety.

Loc. Holborn Island, Queensland (*Hasw.*), Sydney (*Wat.*), California (*B.*). From bottom of ship 'Fayoum' in Suez docks (18) & (20), collected by Crossland; Gimsah Bay, collected by Hartmeyer. [Nice and Ajaccio (*Calvet*).]

MICROPORELLA CILIATA (*Pallas*).

Loc. Cosmopolitan; Engineer Island, Khor Dongola on *Hydrocorallina*, collected by Crossland; Ras el Millan, collected by Hartmeyer.

SCHIZOPORELLA UNICORNIS, *Johnston*. (Plate **12**. figs. 12, 13.)

Lepralia unicornis, Johnst. Brit. Zooph. ed. 2, p. 320, pl. 57. fig. 1 (1847).

Add to Miss Jelly's list of synonyms:—

Lepralia unicornis, Barrois, Embryol. des Bryozoaires, p. 152, pl. 8. figs. 30, 33, 35, 37.

Schizoporella unicornis, Pergens, "Unters. an Seebryozoen," Zool. Anzeiger, Nos. 317–318, p. 12 (1889); Waters, Quart. Journ. Geol. Soc. vol. xlvii. (1891) p. 27; Ortmann, Die Japanische Bryozoenfauna, p. 49, pl. 3. fig. 35 (1890); Calvet, Bry. Mar. de Cette, p. 40 (1902); Bry. Mar. de Côtes de Corse, p. 20 (1902); Bry. de 'Hirondelle,' p. 138 (1903); Nordgaard, Norwegen Fiords, p. 165, pl. 5. figs. 23, 25 (1905); Canu, Bry. Tert. de la Tunisie, Exp. Sc. de la Tunisie, p. 24, pl. 34 (1904); Thornely, "Manaar," p. 114; Neviani, Bull. Soc. Geol. Ital. vol. xv. p. 20, fig. 4 (1896); Bri. d. Form. plioc. & post-plioc., *op. cit.* vol. xvii. p. 11; Bull. Soc. Romana p. gli St. Zool. vol. iv. pp. 6, 14, 20; pt. iv. p. 7; pt. v. p. 13; Bri. foss. di Carrubare, p. 511; Bri. foss. della Farnesina, Paleont. Ital. vol. i. p. 114, pl. 6. figs. 8–11 (1895); Bri. neog. delle Calabrie, *op. cit.* vol. vi. p. 196 (1900).

Reptoporina rugosa, d'Orb. Pal. Franç. vol. v. p. 443. See Waters, Ann. Mag. Nat. Hist. ser. 7, vol. xv. p. 8.

This is a species about which there has been some confusion, and to a large extent it arose through Busk not recognising the differences between this species, *S. sanguinea*, Norm., and *S. spinifera*, Johnst.; but all three can be recognised by the opercula. In *S. sanguinea* the muscular attachment is close to the border, whereas in *S. unicornis* the muscles are attached some little distance from the border. Further, in *S. unicornis* oral glands have not been met with, while in *S. sanguinea* they are large and well developed. Oral glands have not been met with by me in any species of *Schizoporella*, where

the opercular attachments are some distance from the border, but they are known in *S. sanguinea*, Norm., *S. Harmsworthii*, Waters, *S. auriculata*, Hass., *S. serratimargo*, Hincks, *S. arrogata*, Waters, *S. linearis*, Hass.

S. unicornis, J., is one of the most abundant species in the northern hemisphere, and it was also very abundant throughout the whole of the Tertiaries, and therefore it is not surprising that it is subject to considerable variation. It has not been mentioned from Australia, but Mr. Hincks records it from S. Africa.

There are about 18 tentacles, and frequently in large pieces no ovicells are seen. It is frequently darkly pigmented. From the floating stage in Suez docks, which "has been afloat several years," there are pieces 1–2 cm. thick composed of many layers, and from Cape Verde Island there is a piece about 0·7 mm. thick, and about 17 cm. × 14 cm. They are not, however, formed of simply superimposed layers, but of superimposed zoœcia, so that the lateral distal walls are continuous throughout the whole thickness. This regularity is a great surprise, and I hope to deal with it when I describe the Cape Verde collection; however, I may state that *Schizoporella viridis*, Thornely, which also grows in solid pieces, has no such continuous growth, and in section the zoœcia are seen to be one over another, alternately like tiles; also in *Cellepora* there is considerable irregularity. In some solid growths of Bryozoa the layers are almost independent; however, in multilayered Melicertilidæ the cells occur in a definite position one over the other, in a way which surprised me when I made the sections*. The question now raised is a very large one, of some palæontological interest, but it has been recognised too late for full examination in this paper.

Loc. Greenland, Scandinavia, British, Atlantic, Cape Verde Islands, Mediterranean, Indian Ocean, Japan, Loyalty Islands, South Africa (*Hincks*). From Suez Docks (13) (15), Suez Canal entrance (14), ship 'Fayoum,' Suez (20), Agig Suraya (21), Cape Verde Island (2) (3), Zanzibar from bottom of s.s. 'Juba,' which always remains in Zanzibar waters (511), collected by Crossland.

Fossil. Throughout the Tertiaries of Europe from the Bartonian of Italy, occurring in England, France, Austria, Russia, abundantly in Italy, Algiers, and Tunis.

Schizoporella unicornis, var. (Plate **12**. fig. 11.)

There is a form concerning which it is doubtful whether it should be separated as a variety or not. The zoarium is Hemescharan, and often the adnate portion throws up tubular or cup-shaped growths, and the polypides extend diagonally across the zoœcium with the oral aperture in one corner.

* Ann. Mag. Nat. Hist. ser. 6, vol. viii. p. 52, pl. vi. figs. 4, 5 (1891).

This also is seen in typical *S. unicornis*, though not usually as marked. This is what Pallas described as *Eschara spongites* *.

Although many large pieces have been examined, no ovicells have been found. There are about 18 tentacles. The surface pores of this variety are usually larger than those of *S. unicornis* typica.

Pallas described this species, and referred to the diagonal arrangement of the polypides, and (p. 45) says "& osculo, ad alterum plerumque latus declinato." He refers to figures by Imperato, Besler, and Gaultier; but the figures of Imperato are very unsatisfactory, merely representing some incrusting growth on the root of a seaweed, but there is nothing to indicate the genus or species, or even the order. However, I have frequently seen *Schizoporella sanguinea* in the Mediterranean incrusting this seaweed just as figured. Gaultier's figure to which Pallas refers occurs on the back of a titlepage. The titlepage of each part has the figure of a coral on the back, and the tail-pieces are also corals, each with a short description. Gaultier's figure is very characteristic of what I described as *S. errata*, and the inscription underneath is "Porus anguinus crustaceus tubulatus capsulis minimis ex Museo N. Gaultieri, No. 55." This was known as 'Lapis Spongiæ,' and was used medicinally. Doubtless the medicinal efficacy did not depend upon a strict adherence to one species or variety.

This is not the *S. spongites* of Smitt, Hincks, and Thornely, showing how dangerous it is to try and identify species insufficiently described by older authors.

I have seen this variety in Lamarck's collection marked *spongites*, but there were some other things also with the same name.

Loc. Mediterranean, Naples, Corsica. From s.s. 'Thyra' from the Medi terranean, docked in Suez after being there one month (9).

SCHIZOPORELLA UNICORNIS, var. ANSATA, *Johnst.*

There is a small piece on *Lepralia japonica*, Busk, from the Bay of Agig Suraya (21), collected by Crossland. The surface is thickly punctured, there

* *Eschara spongites*, Pallas, Elench. Zooph. p. 45 (1766); Lamouroux, Expos. Méthod. p. 2, pl. xli. fig. 3.

Cellepora spongites, Risso, Hist. Nat. de l'Europe Mérid. vol. v. p. 337.

Lepralia errata, Waters, "Bry. of Naples," Ann. Mag. Nat. Hist. ser. 5, vol. iii. p. 39, pl. 10. fig. 5 (1879); "The Use of the Opercula in the Determination of the Cheil. Bry.," Proc. Manch. Lit. & Phil. Soc. vol. xviii. (1878) pl. 1. fig. 9.

Schizoporella errata, Calvet, "Bry. Mar. des Côtes de Corse," Trav. de l'Inst. de Zool. de l'Univ. de Montpellier, ser. 2, Mém. 12, p. 23 (1902).

Porus anguinus, Gualtieri, Index Testarum quæ adserv. in Museo Gualtieri, figure on the back of the titlepage to part 4 (1742–1744).

Cellepora spongites, Maratti, De Plantis Zoophytis et Lithophytis in Mari Mediterraneo viventibus, p. 56 (1776).

are no ovicells, the umbo is distinct, and the small triangular avicularia at each side are directed upwards, and there are also two large vicarious avicularia like those of *Lepralia occlusa*, Busk (see Pl. **14**. fig. 1). Vicarious avicularia have not been found before, but there are so many cases in which they sometimes occur and sometimes do not, that it is clearly a character to which we must not attach too much importance.

The appearance of *S. unicornis*, var. *ansata*, and *S. linearis* is very similar, but they can be distinguished by means of the opercula.

A specimen from Suez in the British Museum would seem to be this species. It has similar vicarious avicularia, but no ovicells were found. Busk had marked it *Duboisii*, Aud., but I think we are hardly justified in considering it to be that species.

SCHIZOPORELLA ARGENTEA, *Hincks*. (Plate **12**. figs. 17, 18; Plate **13**. figs. 16, 17.)

Schizoporella argentea, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vii. (1881) p. 158, pl. 9. fig. 6; *op. cit.* ser. 5, vol. xv. (1885) p. 254, pl. 9. fig. 6; Thornely, "Manaar," p. 114 (1905).

The zoœcia are granular with small areolations round the border, and in some cases the granules near the border are arranged linearly like the beginning of ribs. There is a fairly large avicularium placed diagonally on the front, though in some pieces none are found. In the Red Sea specimens there is no avicularium in the aperture, nor are there any spines. The sinus of the aperture is very wide, and the operculum on the proximal edge has two projections instead of one, being quite different to any operculum yet met with, though reminding us of the operculum * of the ovicelligerous zoœcium of *Hippothoa hyalina*. The ovicell is large, long, perforated, and granular, and is closed by the operculum.

The dorsal surface has many large tubular projections for attachment; but there is not the regularity described by Hincks, who says "six prominent tubular projections," for in the Red Sea specimens there is sometimes only one. There is no diaphragm separating this radicle projection, and the polypide may be distorted by the irregularity, or the testes may extend into the projection.

There are 16–17 tentacles.

A specimen from Tahiti, sent to me by Miss Jelly, only shows the avicularia to two zoœcia, nor has it the oral spines, or the dorsal regularity described by Hincks. Apparently Hincks must have figured a somewhat exceptional piece, as my specimens are from the same lot as those described by him. In the African specimens the avicularium in the lip is more constant.

Loc. "Africa"; Tahiti; Manaar (*Th.*); Khor Dongola (2), Red Sea, Suakim (7), collected by Crossland.

* Quart. Journ. Geol. Soc. vol. xliii. pl. 8. fig. 43.

SCHIZOPORELLA VIRIDIS, *Thornely*. (Plate **13**. figs. 1–8.)

Schizoporella viridis, Thornely, "Manaar," p. 116, fig. 3.
Schizoporella spiculifera, Busk, MSS.

The zoarium forms solid masses composed of many layers. The zoœcia are distinct, ovate, raised, with large pits having one, or sometimes two, perforations at the base, but between the pits there are very small raised nodules. Oral aperture subtriangular, with a small, acute, triangular avicularium at one or both sides of the sinus. There are large zoœcial avicularia about the same size and shape as the zoœcia, and the mandibles are long and narrow, with an indentation at the base.

The opercula have two muscular dots some distance from the wall of the operculum, and the poster is wide.

There are about 25 tentacles, and no oral glands in the sections cut.

There are but few ovicells, and these are large and globular, wider than a zoœcium. The ovicell is formed of two calcareous layers, and on the outer one there are raised ridges irregularly radial; between these ridges the pores of the lower layer are seen, these pores are much smaller and more numerous than those on the surface of the zoœcia. An ovicell broken down and showing the two layers is figured (fig. 2). The opening of the ovicell, which is a transverse slit, is quite separated from the oral aperture. The ovicell of *Cellepora serratirostris*, MacG.*, has a somewhat similar opening.

The large lateral umbo, figured by Miss Thornely, has not been seen on the Red Sea specimens, and occurs only sparsely in those from Manaar.

S. viridis is in many respects like *Cellepora Raigii*, Aud. (pl. vii. fig. 10), but Savigny figures it with a denticle, and therefore we must suppose that it was *Smittia*. Pl. vii. fig. 11 of Savigny has similar vicarious avicularia, but both this and the last have spines, whereas none are seen in the specimens from the Red Sea. *Schizoporella ampla*, Kirkpatrick †, from Mauritius, has similar zoœcial avicularia : also *Lepralia edax* has vicarious avicularia. The solid masses and the irregular, sometimes erect, form of the zoœcia would suggest *Cellepora* ; but we see the same thing in other *Schizoporellæ*, and are thus shown how artificial the zoœcial characters of *Cellepora* were.

Loc. Manaar, coral-banks (*Th.*); Mediterranean, Busk Coll., Brit. Museum, 99.7.1.2366 (as *S. spiculifera*) ; Khor Dongola, dredged on dead coral, 3 fath., near Engineer Island (1). Mr. Crossland writes: "this green, incrusting species abounds on stones and old cables of the Elect. Tel. Co., Suakim" ; and also says, "the neighbourhood of Engineer Island is characterised by this species" [Khor Dongonab].

* Prod. Zool. Vict. dec. xiii. p. 109, pl. 128. fig. 2.
† Ann. Mag. Nat. Hist. ser. 6, vol. i. p. 76, pl. 7. fig. 4.

LEPRALIA, *Johnston.*

In considering the position of this genus, now used provisionally, some of the remarks will apply to other genera, for many of our difficulties of classification, both as regards species and genera, arise from ignoring the rule that a species or genus must have been SUFFICIENTLY DESCRIBED for it to be retained *.

Lepralia, in the first edition of Johnston's 'British Zoophytes,' comprised 7 species, which, according to present ideas, would stand under 4, or, according to some authors, 5 genera. In the second edition there are 37 species, now placed under 11 genera. Johnston, following the ideas of his time, based his genus on the species being incrusting, but now we know that this is an almost useless character in generic divisions. Hincks retained the name for a part of Johnston's genus, though basing it upon zoœcial characters.

I quite agree with what various authors have said, that it would have been more satisfactory if Hincks had taken a new name, especially as Johnston's first species, *Hippothoa hyalina*, did not fall into the new genus. We now recognise that from Hincks's genera *Lepralia*, *Schizoporella*, and *Cellepora* some species will have to be removed and new groups formed ; yet the major part of Hincks's *Lepralia* have the sides of the oral aperture more or less straight, or slightly curved with the proximal edge nearly straight, and with a lateral elongation at the side to which the muscles are attached. This has been called *Hippoporina* by Neviani ; but regarding this, further study is required, as the type of *Hippoporina* has an enlarged ovicelligerous zoœcium, whereas some others have an external ovicell.

As already stated, the first species, *Hippothoa hyalina*, did not fall into Hincks's genus, as it belonged to a genus previously created by Lamouroux; and it has been suggested that as the so-called type has gone, we must turn to the second species, *Lepralia nitida*, and take it as the type, and now replace the name *Membraniporella* by *Lepralia* ; but this is surely repeating Hincks's mistake in a very exaggerated form, and causing confusion in several genera.

How impossible it is to retain these old names at all cost is shown when we consider what the genus *Cellularia* was made to include, at least 8 genera of Cheilostomata and one of Cyclostomata. The first species is a *Tubucellaria*, but the genus *Cellularia* has been used in a variety of ways and its spelling altered. When we study the generic diagnosis of the older zoologists, say even of careful zoologists like Pallas and Gray, we often find that absolutely

* If a species is not recognisably described, then it is surely in the position of a manuscript species, and most workers coming upon a species only described in manuscript would adopt that name if there were no reason against so doing, but they are under no obligation to do so.

no character of any value is given, and the attempt to put new wine in old bottles has proved entirely impossible, and is causing great confusion in the nomenclature of the Bryozoa. Some of the diagnoses have conveyed so little information, that to help ourselves out of a difficulty we instinctively look to see what was included ; but then to take the first species, and say that is the type of a heterogeneous group incorrectly and insufficiently described, is not making for stability of classification. The rule that, if nothing is said to the contrary, the first species mentioned must be considered as the type, was not made so that, when an utterly inadequate diagnosis was given, yet we must of necessity retain this name for a genus, to be afterwards fully described, containing this species.

However, a little more patience is still required, and I would repeat that we must not be in too great a hurry over re-classification, although recognising that important changes must come, and future classification must include new characters, for useful ones will be found in the opercula, their shape, attachment, and muscles ; in varying characters of the ovicell—whether it is closed by the operculum or not ; in the position of the testes and ovaria ; in the nature of the oral and avicularian glands ; in the way in which the zoœcia are connected through the rosette-plates or pore-chambers ; in the primary zoœcia : on the other hand, we have to recognise that Hincks attached far too much importance to peristomial characters. Thus, while recognising that changes will be made, present generic names and generic groupings can be provisionally used, and it is known that two or three competent workers are giving classification close attention, and in all probability we shall find that the present one gives us a useful basis, and that many known genera will be retained after removing species incorrectly placed in them.

Out of the genus *Lepralia* of Hincks, *Hippoporina*, *Cyclopora*, and *Monoporella* have been formed.

LEPRALIA JAPONICA, *Busk*. (Plate **13**. figs. 10–12.)

Lepralia japonica, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 143, pl. 17. fig. 5 ; Waters, Zool. Chall. Exp. vol. xxxi. pt. lxxix. p. 26 (1889) ; Ortmann, "Japanische Bryozoenfauna," Arch. f. Naturgesch. vol. i. p. 39, pl. 1. fig. 11 (1890).

Semieschara magna, d'Orb. Pal. Franç. vol. v. p. 367 (1851). See Waters, Ann. Mag. Nat. Hist. ser. 7, vol. xv. (1905) p. 6.

Lepralia gigas, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xv. (1885) p. 255, pl. 9. fig. 8 ; Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. i. (1888) p. 78 ; Thornely, "Manaar," p. 120 (1905).

Lepralia gigantea, Busk MSS. Brit. Mus. Coll.

This occurs from the Sudan with unilaminate broad tubes (say 10 mm. diam.), which anastomose irregularly, forming a very large growth, for some pieces about 70 mm. across are evidently only fragments of large colonies.

There are about 25 tentacles. Only very few zoœcia containing polypides have been found, and these only in a very unsatisfactory condition; evidently good specimens are likely to reveal structures of interest.

The 'Challenger' specimens have a broad avicularium by the side of the aperture, but they were not abundant, and were overlooked by Busk; and, as mentioned in my 'Challenger' supplementary Report, the ovicell has very minute perforations. The ovicells are similar from all localities. The internal base of the ovicell has about three rows of large pores (fig. 10), and the lateral, distal, and basal walls of the zoœcia have moderate-sized pores evenly distributed over the surface. On the distal wall there may be about 10–15 pores. Sections show that two of the tentacles are larger than the others, extending beyond them, and having more large nuclei. This is the case in a large number of species.

Mr. Crossland notes that "large quantities of this Polyzoon * were trawled in the Bay of Agig Suraya (in the south part of the Sudan coast). The tubular branches are inhabited by a species of the Polychæte worm *Chœtopterus*, and afford habitat to a very large number and variety of small Polychæta; smaller crustacea are fewer."

Loc. Cobie, Japan, 8–50 fath. (*Chall.*); Sagamibai, Kadsiyama, slight depths, Maizuru, 35–40 fath., Japan (*Ortm.*); Island of Enoshima, near Yokohama (*Waters coll.*); Mauritius (*Kirkp.*); Trincomalee, as *L. gigas*, Hincks, and as *L. gigantea*, Busk, MSS., both specimens apparently received from Dr. Johnston (in Brit. Mus.); Gulf of Manaar (*Thornely*). Khor Dongola, on shells (2), off Skukak, 9 fath. (11), trawled in the Bay of Agig Suraya (21), Red Sea; Wasin, Brit. East Africa, 10 fath. (501), collected by Crossland.

LEPRALIA ? CUCULLATA, *Busk*. (Plate 15. figs. 1–5, 10.)

Lepralia cucullata, Busk, Mar. Polyzoa, p. 81, pl. 96. figs. 4, 5 (1854); Heller, Verh. der k.-k. zool.-bot. Gesellsch. Wien, vol. xvii. (1867) p. 112; Manzoni, Bryozoi del Plioc. ant. di Castrocaro, p. 31, pl. 4. fig. 47 (1875); Waters, "Bry. of Naples," Ann. Mag. Nat. Hist. ser. 5, vol. iii. (1879) p. 40, pl. 10. fig. 4; "Use of the Opercula, &c.," Proc. Manch. Lit. & Phil. Soc. vol. xviii. (1878) pl. 1. fig. 14; Seguenza, "Formaz. Terz. nella Prov. di Reggio," R. Accad. dei Lincei, a. cclxxvii. ser. 3. vi. (1880) pp. 329, 370; Calvet, "Bry. Mar. de la Région de Cette," Inst. Zool. de l'Univ. de Montpellier, ser. 2, p. 52 (1902); "Bry. Mar. de Corse," *op. cit.* p. 27 (1902); Thornely, "Manaar," p. 120 (1905); Records of the Indian Mus. vol. i. pt. 3, no. 13, p. 190 (1907).

? *Cellepora ovoidea*, Audouin (*non* Lam. & Lamx.), 'Desc. de l'Égypte,' Hist. nat. vol. i. p. 238, pl. 8. fig. 1.

Lepralia atrofusca, Busk, J. Micr. Sc. vol. iv. (1856) p. 178.

Microporella Watersi, De Stefani, Jejo Mont e Capo Vat. p. 129 (1884).

Schizoporella atrofusca, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xvii. p. 269, pl. 10. figs. 4, 5; also var. *labiosa*, Hincks, 1886.

* This is the branching tubular form referred to by Crossland on p. 8 of this volume.

Smittia cucullata, Neviani, "Dei Bryoz. foss. Ital. 2ª, cont.," Boll. Soc. Geol. Ital. vol. xii. (1893) p. 125.

Smittia (subgenus *Watersipora*) *cucullata*, Neviani, "Brioz. foss. della Farnesina e Monte Mario," Paleont. Italica, vol. i. p. 120 (1895); "Brioz. Neog. delle Calabria," *op. cit.* vol. vi. p. 209 (1900).

There is considerable variation in the peristome, so that both in the Mediterranean and in the Atlantic the var. *labiosa*, so named independently by both Hincks and Calvet, is found, as well as the type.

Some of the Red Sea specimens have quite thin shells, whereas in those I have seen from Naples, Trieste, Rapallo, and Cape Verde the shell is thick, and in these the whole zoarium is very dark, whereas those from the Red Sea are much lighter; some are even without pigment, only the operculum being dark.

The operculum is very characteristic and does not vary in any of the forms; at the side there are the two lighter places in the very dark operculum, and the two small hollow knobs near the base are distinctly seen. These apparently act as stops when the operculum is open (figs. 2, 3), and then the operculum is bent back nearly at right angles. The ovaria grow at the side of the zoœcium, but the ovum passes for development into a sac at the distal end by the basal wall (fig. 4). This ovicell is what I have called a concealed ovicell.

There are about 23–24 tentacles, with two larger than the others.

No oral glands were found in the young or the mature zoœcia until the ovicell was forming; however, when the ovaria are becoming large, two bodies begin to grow from the fleshy mass on the operculum (fig. 10), and when the ova are in the ovicell these become moderate-sized glands. This misled me at first into believing that there were no glands, and possibly glands will be found in the fully mature zoœcia of other species where they have not yet been seen.

In specimens from Trieste there is a band of darkly pigmented cells all round the stomach. A band of dark cells is known to occur in other species, but I have never seen any so dark as these; although they have been called liver-cells, they should perhaps be termed pancreatic.

Loc. Ægean Seas (*Busk*), Adriatic, Naples, Trieste, Rapallo, Cette, Corsica, Mazatlan (*Busk*), Azores (*Calv.*), Manaar (*Thornely*), Galle and Cheduba (*Th.*), Arabian Sea (form *labiosa*), British Museum Coll.; "Cape St. Lucas," California, in British Museum, S. Africa (fide *Burrows*). Bottom of sailing-boat, Suez (16), s.s. 'Thyra,' Suez (9), Canal entrance, collected by Crossland; Ras el Millan, Sinai coast, collected by Hartmeyer; Cape Verde Islands, collected by Crossland.

Fossil. Miocene, Pliocene, and post-Pliocene, from various localities in Italy.

Lepralia robusta, *Hincks*. (Plate **13.** figs. 13, 14.)

Lepralia robusta, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xiii. (1884) p. 360, pl. 13. fig. 4; Journ. Linn. Soc., Zool. vol. xxi. (1887) p. 131; Thornely, "Manaar," p. 119 (1905).

The pore alluded to by Hincks and Thornely, but not figured, is not seen in my specimens. There are, however, pores at the base of the avicularium which might sometimes appear to be below the oral aperture. The avicularium has a thin bar across, which is in parts broken away.

Loc. Mergui Archipelago (*Hincks*); Gulf of Manaar (*Thornely*); Khor Dongola (6), Sudan Exped., collected by Crossland.

Lepralia occlusa (*Busk*). (Plate **13.** fig. 15; Plate **14.** figs. 1–9, 13.)

Escharoides occlusa, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 150, pl. 21. fig. 8 (1884).

Lepralia occlusa, Waters, Zool. Chall. Exp. vol. xxxi. p. 26, pl. 3. figs. 32–34 (1889); Kirkpatrick, Proc. R. Dublin Soc. n. s. vol. vi. (1890) p. 612.

Zoarium much branched, about 50–70 mm. high; branches compressed.

There are vicarious avicularia having duck-billed shaped mandibles, spreading from a straight base (fig. 15). A 'Challenger' specimen, from Station 186, Cape York, has these avicularia, and they occur in the specimens from British East Africa. There is in the Sudan specimens a small semicircular avicularium at the proximal end of the zoœcium, and in the Zanzibar specimens there are, besides this, also other semicircular ones scattered over the zooecium.

Tentacles 17–19.

There is a large multilobular gland situated at the distal end, near to the basal wall. A lobe may be hollow in the middle or closed, and may contain a homogeneous mass of small yellowish particles which do not stain. In the gland there are frequently semitransparent slightly refractive masses which may have the edges, in part, more or less straight or angular, while these masses sometimes appear amorphous (fig. 8). This gland is nearly round, or contracted towards the middle to form two hemispheres. The single duct from the gland is directed upwards, that is towards the operculum; but shortly it divides into two, sometimes at the division expanding and forming two nearly globular organs (fig. 13), and the two tubes are continued to the diaphragm. These tubes or ducts have thick cellular walls (fig. 4), and the contents of the tubes are the same yellowish unstainable material, sometimes containing bodies with more or less straight edges, as just described in the lobes.

The gland, and sometimes the lobules, are surrounded by a membrane with nucleated cells (figs. 8, 9). The number of lobes is considerable, and may reach to at least thirty.

Although all points are not fully elucidated, these are undoubtedly the oral glands to which I have referred in various papers. These glands were described in one species by Ostrumoff * in a Russian paper, of which a French translation was given in the 'Archives Slaves de Biol.' †, and were mentioned in my 'Challenger' Suppl. Report, as well as in a paper "On Gland-like Bodies in the Bryozoa" ‡, and in subsequent papers §.

The oral glands are structures for which I have been on the look out for many years; but a large proportion of the specimens received are not in a suitable condition for such examination, so that although I have cut sections of hundreds of species, as much has not been learnt about them as I hoped. However, I am now in a position to state that the glands occur in a large number of species in very varying forms and sizes, but only, so far as we know, in what we may for simplicity call the calcareous forms, that is, in the *Escharina* of the older authors, being usually absent in the *Cellularidæ*, *Membraniporidæ*, *Flustradiæ* ||, &c., though even here there are traces in some which are probably vestigial, as in *Bugula bicornis*, Busk, &c.

* Obshchestvo Estestvoispuitatelei, Kazan, vol. xvi. p. 26, pl. 1. fig. 17 (1886).

† "Étude Zool. & Morph. des Bry.," Arch. Sl. de Biol. vol. i. (1886). (The translation omits the description of *Lepralia pallasiana*.)

‡ Journ. Linn. Soc., Zool. vol. xxiv. (1892) p. 272, pl. 19.

§ A large gland is figured in the description of *Retepora hippocrepis*, Waters, Voyage du S.Y. 'Belgica,' p. 85 (1904), and in *Rhamphostomella costata*, Lorenz, Journ. Linn. Soc., Zool. vol. xxviii. (1900) pl. 12. figs. 1, 2.

|| [Since this paper was read Dr. Levinsen has given me a most interesting piece of *Flustra abyssicola*, Sars. In each zooecium hanging from the centre of the opercular region there is one yellow sac with homogeneous contents in the upper part, and darker granular or cellular contents in the lower. This occurs in zoœcia with polypides, but is more conspicuous in older and empty zoœcia, and then at the base of this sac, surrounding the end, there are a number of large cells looking much like small ovarian cells. There are, however, ovaria in the same zoœcia. Dr. Levinsen also gave me a *Flustra* much like *F. carbasea*, E. & S., which has two long narrow bodies at the side of the zoœcium suspended by a distinct duct. In longitudinal sections it is found that in some cases there are in these bodies conical groups of cells directed inwards towards the lumen. Sometimes these cells only occur in patches, and the walls are thick and structureless, so that in some states the greater part of the body is homogeneous. Haddon figured similar bodies in what he called *F. carbasea* in his "Budding in Polyzoa," pl. 38. fig. 12, as *l. c.*, but he did not allude to them in the text.

From sections made, it seems that these bodies and those in *F. abyssicola* may be testes, and, as already stated, Jullien described a gland in *Cribrilina figularis* as a testis (see Mém. de la Soc. Zool. de France, i. p. 270, pl. 10. figs. 1, 2, 1888). I have for many years made vain efforts to obtain *C. figularis* in good condition for examination. In many species of Bryozoa glands have been found in zoœcia together with well-developed lateral testes, and it appears that oral glands may have different functions. Both species will be further studied and shortly figured, and it is to be hoped that they may help towards clearing up some of the difficulties.]

In *Reteporidæ* they appear to be quite constant and well developed large sacs ; also in the holostomatous *Celleporidæ*, which should be separated as *Holoporella* *, they are very long and tubular, or even irregularly twisted (Pl. **16**. fig. 7). In *Smittia* they are apparently always found, being very minute sacs close up to the tentacular sheath (Pl. **15**. fig. 11). In *Lepralia* they occur well developed in some species, though not so large as in *Retepora*, and it is one of the characters which must be used in endeavouring to bring the three genera *Schizoporella*, *Lepralia*, and *Cellepora* into better order. In *Schizoporella* they occur in some species, but I have so far only found them in species which have no muscular attachment close to the border, while in those with the muscular dots nearer together, as in *S. unicornis*, they have not been found.

It will be seen that in a large number of species each gland is divided into two distinct parts, but the most highly developed of all is that of *Lepralia occlusa*, Busk ; then we pass to those with a terminal sac, as in *Schizoporella sanguinea*, Norm. ; next to those with only the one part, which may develop into long contorted tubes as in *Holoporella vermiformis*, nov. (Pl. **16**. fig. 7) ; or, finally, they may occur as only a pair of small globes, consisting of but few cells close to the tentacular sheath, as in *Smittia*. In *Cellepora caminata*, Waters, the glands are tubular, forming a lobe. This interesting species should be further studied in fresh material. The glands of *Lepralia eliminata*, Waters, are perhaps the most curious yet met with, and I therefore add figures (Pl. **14**. figs. 10, 11). At the end of the first tubular portion, and with only a slight attachment, there is a round globe which in sections is homogeneous or contains in parts, usually the upper part, stout rods or vermiform bodies. These rods may be seen in the upper portion of the duct or gland, and occasionally there seem to be traces of large cells in the globe. The glands of this species I am unable to understand.

In various species I have seen a few abnormal growths of a smaller gland attached to the larger one, as figured in my Suppl. 'Challenger' Report, pl. iii. fig. 15, but this structure is rare.

In the avicularia there are also glands in a large number of species, and I figured those of *Lepralia foliacea*, Ell. & Sol.† (figs. 1, 4, 5), and *Retepora cellulosa*, L.† (fig. 14). They also occur in the avicularia of *Lepralia margaritifera*, Q. & G., *L. clivosa*, Waters, *Microporella ciliata* var., *Smittia trispinosa*, Johnst., *Porella plana*, Hincks, *P. acutirostris*, Smitt, &c. The avicularian glands have also similar yellowish homogeneous contents, sometimes with semitransparent bodies with more or less straight edges, as in

* In the 'Challenger' *Cellepora hastigera*, B., there are enormous glands extending nearly the length of the zoœcium, and again turned back about half this length, but the state of the Brit. Mus. slides does not permit of further study.

† Journ. Linn. Soc., Zool. vol. xxiv (1892) pl. 19. figs. 1, 4, 5, 14.

L. occlusa, and generally in the oral glands. Attention may be called to the fact that the glands, as a rule, occur in all the zoœcia, and are not dependent upon the sexual condition of the zoœcium, so that they do not seem to be connected with sexual processes. However, in *Lepralia cucullata*, Busk, which has a concealed ovicell (Pl. **15**. fig. 4), the glands only begin to grow when the ovicell is forming. In *L. occlusa* the gland is formed in the youngest zoœcia, when the polypide is quite immature, and it looks like a growth from the tentacular sheath.

There is no absolute proof as to the function of the glands, and some experiments I made many years ago on feeding with colours were not satisfactory, for the difficulties when dealing with opaque calcareous organisms are very great. Calvet *, however, states that he has not found that the glands absorb colour. There has always seemed much to suggest their being excretory organs, and in animals without a circulatory system we must not expect any such organ to exactly resemble those where there is an active circulation, nor with such glands surrounded by a membrane must we take it for granted that colour would be absorbed in the same way. The position † and varying shape also suggest comparison with salivary glands of insects, worms, &c., but we are confronted by the fact that there are similar glands in the avicularia ; now these have no digestive organs, whereas the salivary glands are supposed to have a digestive function.

I have induced my friend Mr. Henry Waddington, F.L.S., to grow some Bryozoa in his aquarium in order to study this organ in specimens in perfect condition, and perhaps with his success in keeping marine animals, and his skill in microscopical manipulation, he or we may be able to throw light on the function of the organ.

However, to return to what we definitely know. There is a secreting-gland, having very different forms in various species, which pours out the secretion close to the diaphragm, that is at the external opening. Should proof be found that these glands only remove waste products, then I suppose they must be called excretory.

Very minute excretory organs are known in *Loxosoma* and *Pedicellina*, and have been described by Nitsche, Hatschek, Joliet, Harmer, Föttinger, Ehlers, Prouho, Schulze, and Gustav Stiasny ‡, who have cleared up points which were still uncertain; also Cori and others have considered that excretory organs occur in the Phylactolæmata ; there is, however, no similarity between these small organs and those of the Cheilostomata.

* 'Bryozoaires Ectoproctes Marins,' p. 286 (1900).

† The similarity is perhaps not so great as appears at first sight, for the glands are not attached directly to the movable polypide, but to the zoœcium which contains it, and it should be remembered that what is called the diaphragm is really a sphincter.

‡ "Beitrag zur Kenntniss des Exkretionsapparates der Entoprocta," Arbeit. zool. Inst. Wien, vol. xv. p. 183, pl. 1 (1905).

The genus *Escharoides* cannot be retained. Milne-Edwards gave the name for a "subgenus" of *Cellepora* for "espèces dont les cellules sont rangées sur un seul plan et sont libres ou du moins bien distinctes dans une grande partie de leur longueur." The species included are a most heterogeneous group, the first-named being *Cellepora ovoidea,* Lamx., a species so slightly described that we shall never be sure what was intended. Smitt and Busk took the name for species with an avicularium in the lip, though not in any way corresponding with any of the species mentioned by Milne-Edwards.

In all probability a new genus must be made for *L. occlusa* on account of the peculiar glands, but it is better to wait until the glands have been studied in various allied species.

Loc. Crozet Isl., 210 fath.; Cape York, 8 fath.; Samboangan, 10 fath. (*Chall.*); Torres Straits (*Kirkpatrick,* and also var. *areolata,* K.); Murray Island, Torres Straits, 15–20 fath. Wasin, Brit. East Africa, 10 fath. (501 & 520), Ras Osowamembe, Zanzibar Channel, 10 fath. (504), Bay of Agig Suraya, South Sudan Coast, trawled (21), collected by Crossland.

Smittia spathulata, *MacGillivray.*

Smittia reticulata, var. *spathulata,* MacG. Trans. Roy. Soc. Vict. vol. xix. (1882) p. 135 (6), pl. 3. fig. 14.

Smittia reticulata, var., Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. viii. (1881) p. 123, but not var. *spathulata,* Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xix. (1887) p. 304, pl. 9. fig. 3, which is my *S. reticulata,* var. *inæqualis.*

Smittia spathulata, Kirkpatrick, Proc. Roy. Dublin Soc. vol. vi. (1890) p. 619, pl. 17. fig. 1.

From Khor Dongola there is a specimen with the zoœcia placed very irregularly. The zoœcia have large pores round the border, a broad avicularium on one side usually directed downwards, the peristome raised on each side, and two supra-oral spines.

There are small round oral glands more or less attached to the tentacular sheath. The glands of *Smittia* are all small so far as my examination goes, though they are somewhat larger in the *S. Landsborovii* group than in the *reticulata* group. In appearance this is much like the *Cellepora Raigii,* Audouin, but there are pores round the border in these Red Sea specimens, and the avicularia usually are directed downwards, though with the irregular zoœcia it is often difficult to know to which zoœcium an avicularium belongs, in fact they often appear to be quite independent.

Loc. Bass Straits; Victoria; Murray Island, Torres Straits; Brit. E. Africa (520), Khor Dongola (2), collected by Crossland; Ras el Millan, collected by Hartmeyer.

SMITTIA MARMOREA (*Hincks*). (Plate **13**. fig. 9.)

Lepralia marmorea, Hincks, Ann. Mag. Nat. Hist. ser. 4, vol. xx. (1877) p. 214.
Smittia marmorea, Hincks, Brit. Mar. Polyzoa, p. 350, pl. 36. figs. 3–5.

There are only a few dried zoœcia as figured, and although it, at first glance, seems to be *Schizoporella*, the resemblance to Hincks's figure of *S. marmorea* is so close that it seems advisable to consider it as that species. The zoarium is incrusting, and the zoœcia are subovate, smooth, with a row of pores round the border; below the aperture, and a little to one side, there is an avicularium close up to the peristome. The peristome is much raised, but is sometimes wanting at the distal end, and may be wanting at the proximal. No lyrula is visible; but the peristome, the shape of the operculum, and other characters are similar to those in the *S. reticulata* group; however, the lyrula may be deeper down and so out of sight. The ovicell is unknown. Specimens like this occur from the Mediterranean and other places in the Red Sea, but none seen were in a satisfactory condition for study.

This may be the *Flustra Legentilii*, Audouin.

Loc. Suez (14), collected by Crossland.

SMITTIA EGYPTIACA, sp. nov. (Plate **15**. figs. 6, 9.)

The adnate zoarium has the zoœcia arranged radially and biserial—that is, the zoœcia are in two longitudinal rows side by side, and then on each side of the two rows there is a straight, very thick divisional wall (fig. 9).

I have described and figured a very similar structure in a fossil called *Cellepora biradiata*, Waters *. Zoœcia subquadrate, only slightly raised, distinctly separated, surrounded by a row of large pores, surface granular. Oral aperture with a broad lyrula, and at each side, higher than the aperture, a small triangular avicularium directed downwards. The operculum has a chitinous ridge, curved upwards on each side and nearly meeting towards the middle of the operculum (fig. 8). *S. obstructa*, Waters, and *S. tripora*, Waters, both have more or less of a ridge across the operculum. The ovicells are wide, raised, globular, perforated within an area.

S. egyptiaca is somewhat like *S. dentata*, Waters, from the Antarctic, but in the former the avicularia are placed higher and the lyrula is not dentate.

The Zanzibar specimens have the surface smooth to slightly granular.

Loc. Khor Dongola (19) and Engineer Island, collected by Crossland; Ras el Millan, Sinai Coast, collected by Hartmeyer; Wasin, Brit. East Africa (520), collected by Crossland.

* Quart. Journ. Geol. Soc. vol. xli. (1885) p. 306, pl. 7. figs. 11, 12.

SMITTIA EGYPTIACA, var. HEROOPOLITA, nov. (Plate **15**. figs. 7, 8.)

This has the zoœcia in a double row as in the type, and has the chitinous ridge on the operculum as in *S. egyptiaca*, nov., but the zoœcia are small, the side of the aperture is more raised, and there are larger avicularia at the border of the ovicell and elsewhere. The specimens have ovicells to almost all the zoœcia.

Loc. From buoy at the entrance of the Canal at Suez (14), collected by Crossland.

RHYNCHOZOON CORRUGATUM (*Thornely*). (Plate **12**. figs. 14–16.)

Rhyncopora corrugata, Thornely, "Manaar," p. 118, fig. 5.

Zoarium adnate. Zoœcia lageniform, with large raised peristome, more elevated at the sides than elsewhere, and within it a small circular avicularium which, in dried specimens, sometimes looks like an irregular denticle. The surface of the zoarium is frequently covered with large nodules. The ovicell is recumbent, rather straight at the sides, with a large circular area at each side. The oral aperture is nearly round, with a wide "poster," and the operculum, which is of the *Lagenipora* type, has the muscular dots some distance from the border.

An imperfect dry specimen from a buoy at Suez was not understood until an undetermined specimen in better preservation from Suez Bay was found in the British Museum (Busk collection). After these specimens had been studied and figured, Miss Thornely kindly showed me her Manaar collection, and assisted me in the examination of the Liverpool University collection.

The nodules on the Manaar specimens are not so pronounced as those from the Red Sea, in fact are sometimes absent. The peristome is, however, raised in the same way, and there is sometimes an avicularium within the peristome ; the denticle may then be the end of the avicularian chamber; and in the Manaar specimen, even when no avicularium is visible, there is sometimes a tube by the wall of the peristome, as if leading to an avicularian chamber.

The zoœcia of specimens from the buoy are larger than those in the British Museum, and from the variation in the secondary aperture I have a suspicion that *R. corrugatum* and *R. incisor*, Thornely, may be found to be the same species. I did not see any *R. incisor* in Liverpool with ovicells.

Loc. Gulf of Manaar (*Thornely*) ; buoy at the entrance of the Suez Canal (14), Crossland collection ; Suez Bay (Busk coll.), British Museum, 99.7.1.2012.

LAGENIPORA COSTAZII (*Audouin*), var. SPATHULATA, *MacGillivray*.

Cellepora Costazii, var. *spathulata*, MacG. Prod. Zool. of Victoria, dec. xv. p. 185, pl. 148. fig. 6.

Zoarium pisiform. Zooecium erect, ovate; peristome not much extended, with a triangular avicularium at one side. Operculum nearly round, with the muscular dots a distance from the borders. Only one vicarious avicularium has been found. Ovicell rather higher than is usual in *Lagenipora*, area perforated round the border.

There are 13 tentacles.

I believe that this is the *C. Costazii* var. for which MacGillivray suggested the name *spathulata* *, though there is no mucro, neither does MacGillivray figure any. Also in some other species he speaks of a mucro where none is figured.

Neviani has made a genus *Costazia* †, of which the *L. Costazii* is the type; but his *Costazia celleporina*, Nev. ‡, belongs to the holostomatous group, showing that the genus was not based upon satisfactory characters.

Lagenipora seems to be a very natural group, the opercula throughout being similar, and in most cases about the same size; also the ovicell at the side of the peristome has a flat area and pores round the border.

Loc. Dredged at Suez, among lamellibranchs covering the dock walls (no. 18).

HOLOPORELLA, gen. nov.

The lower lip of the aperture is more or less straight, the operculum has the muscles attached near the border, sometimes with a ridge § running inwards; the ovicell is a widely open cap. There are usually oral and vicarious avicularia, and the mandible of one of the two usually has a small projection from the base which Busk called the columella. Most species have an exceedingly minute avicularium at each side of the zooecium, at the distal end, but in some they are no longer functional, only vestigial (Pl. 17. figs. 22, 23); also the oral glands are long and tubular, sometimes irregularly folded. Many species are very dark, nearly black.

In 1879 I showed that the operculum of *Cellepora sardonica*, Waters, had a straight proximal edge; and Busk, in his 'Challenger' Report, makes a division (§ 1) of forms of *Cellepora* with a straight border to the oral aperture,

* Zool. of Victoria, dec. xv. p. 185, pl. 148. figs. 5, 6 (1887).

† "Bri. Neog. di alcune Loc. Ital." pt. ii., Boll. Soc. Romano per gli Studi Zool. vol. iv. p. 239 (15), 1895.

‡ "Coral e Bri. Neog. di Sardegna," Boll. Soc. Geol. Ital. vol. xv. p. (24), 1896.

§ The opercula of many Bryozoa have a ridge for the attachment of the tentacular sheath.

and also said that the avicularian mandible usually had a short median columella, but that it was absent from *C. sardonica*, Waters, and that this structure seemed to be confined to species from the southern hemisphere. As I have since shown, *C. sardonica* has two kinds of avicularia, one of which has a columella, and it is curious how in other species the columella occurs for the most part in one of the two but not in both; however, it is perhaps more frequent in the vicarious avicularia than in the oral. There are a large number of species in the north and south tropics, in fact the holostomatous forms are much more largely represented in the tropics than the schizostomatous *Cellepora*.

In 1888 MacGillivray *, speaking of the *Cellepora* as forming two groups—the Holostomata † and Schizostomata—separated *Schismopora* from *Cellepora*; but, as I have already indicated elsewhere, this was unfortunate, as all the species which we have long known as *Cellepora*, including what we may call the types, were thereby removed from *Cellepora*, and this new division, the Holostomata, remained under *Cellepora*.

It will be recognised from my description that what I propose to call *Holoporella* has various characters by which it is very distinctly separated from *Cellepora*; and already from the old *Cellepora* a number of species have been removed to *Lagenipora* and *Palmicellaria*, and others fall into *Osthimosia*, Jull., or *Schismopora*, MacG.

In these Red Sea collections there is one *Lagenipora*, but otherwise the Schizostomata group of the old *Cellepora* is unrepresented, which is strange considering how numerous they are in the Mediterranean, though we may still expect various species to be found in the Red Sea.

Where the mandible has a columella, then the lucida always seems placed higher up than when there is no columella.

Although the minute avicularia alluded to have not been mentioned previously, yet in various stages of development and frequency they occur in *C. albirostris*, Smitt; *C. apiculata*, Busk; *C. fusca*, Busk; *C. hastigera*, Busk; *C. honolulensis*, Busk; *C. aspera*, Busk; *C. jacksoniensis*, Busk; *C. tridenticulata*, Busk. We must be alive to the possibility of some of these being synonyms.

One species of *Holoporella* was, in a paper by Hincks, placed under both *Monoporella albicans*, Hincks, and *Schizoporella aperta*, Hincks, and is still quoted under these two names, although Hincks ‡ in a subsequent paper recognised their identity. An examination of the opercula would at once have shown that in spite of a different appearance of the specimens the

* Prod. Zool. Vict. dec. xvii. p. 241 (1888).

† Ortmann in 1890, 'Japanische Bry.' pp. 15, 16, makes the subfamily Holostomata for *Lepralia*, *Smittia*, &c., and Schizostomata for *Schizoporella*, &c.

‡ Ann. Mag. Nat. Hist. ser. 6, vol. ix. (1893) p. 176.

structure was the same, and also that there was no relationship with *Schizoporella* *.

The species of *Holoporella* known from the tropics are *H. aspera* (Busk); *H. albirostris* (Sm.); *H. aperta* (Hincks); *H. columnaris* (Busk); *H. discoidea* (Busk), and var. *frutetosa*, Kirkp.; *H. fusca* (Busk); *H. granulosa* (Hasw.); *H. fossa* (Hasw.); *H. imbellis* (Busk); *H. lævis* (Hasw.); *H. mamillata* (Busk); *H. speciosa* (MacG.); *H. simplex* (MacG.); *H. tridenticulata* (Busk); *H. samboangensis* (Busk); *H. turrita* (Sm.); *H. Descostilsii* (Aud.); *H. vermiformis*, nov.; *H. pigmentaria*, nov.

The diagnosis of *Monoporella*, Hincks, would apply to *Holoporella*, but *H. nodulifera* and *H. lepida* could not be united to *Holoporella*, so that a fuller diagnosis of *Monoporella* is required, as it is probably a good genus.

HOLOPORELLA APERTA (*Hincks*). (Plate **18**. figs. 20–23.)

Schizoporella aperta, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. ix. (1882) p. 89, pl. 5. fig. 3; *op. cit.* ser. 6, vol. xi. p. 176 (1893); Thornely, "Manaar," p. 114 (1905); Rec. of Indian Museum, vol. i. pt. 3, no. 13 (1907) p. 189.

Monoporella albicans, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. ix. (1882) p. 86, pl. 5. figs. 5 *a*, *b*; Waters, *op. cit.* ser. 7, vol. xv. p. 16; Thornely, "Manaar," p. 113 (1905).

Cellepora brunnea, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xiii. (1884) p. 30; Journ. Linn. Soc., Zool. vol. xxi. (1887) p. 132.

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* As the examination of the opercula has so largely assisted in establishing this genus, it may be well for a moment to consider why it is, that the operculum furnishes such useful characters in classification, in fact far away the most useful. When in my paper "On the use of the Opercula, &c." (Proc. Manchester Lit. & Phil. Soc. vol. xviii. p. 8, pl. i., 1878), I first showed how they might be used, it was principally as indicating the shape ofthe oral aperture, which it is often difficult or impossible to examine, for the peristome may hide the aperture, or it may even be well inside the zoœcium, directed towards the distal end. In nearly all cases the amount of individual variation is extremely small, so that in a slide of 50 opercula there may be no apparent variation. The importance of noticing the position of the muscular attachment was alluded to, and this is a point that extended examination shows is of the first importance.

The operculum as it must now be studied, however, shows not only the size and shape of the aperture, but also the position of the muscles in the zoœcium; and it is influenced by the compensation-chamber, by whether it has to close the ovicell, and by the way in which the tentacular sheath is attached. The operculum is nearly always hinged to teeth or condyles at each side, and these are often indicated on the opercula, and, further, from the operculum grows the tentacle-sheath for the new bud. Thus the operculum alone bears the impress of many important zoœcial characters.

The mandibles also furnish some characters, but are extremely variable in size and are subject to great modifications, and we must not expect them to give as valuable information as the opercula. The positions of the muscles, lucida, and columella are, however, useful.

I may add that many species can be determined by means of decalcified sections alone, and as the anatomy is more studied it will be possible to determine a larger number in this way.

? *Schismopora cucullata*, Maplestone, "Lord Howe Island," Proc. Roy. Soc. Vict. n. s vol. xvii. (1905) p. 389, pl. 29. figs. 7, 8.

Cellepora albicans, Waters, Quart. Journ. Geol. Soc. vol. xxxviii. (1882) p. 512.

There is no true opercular sinus, but there are two wide denticles in the oral aperture, which sometimes nearly meet and are frequently unsymmetrical. The operculum is entire below, and in the same way "*Schizoporella*" *subsinuata*, Hincks, has a notch in the peristome without the operculum corresponding, and has therefore to be removed from *Schizoporella*. These teeth in the specimens from Ras el Millan are very pronounced (see Pl. **18.** fig. 20), but in those from the Bay of Agig they are small and only form a square notch. There are two or four tapering oral spines and a minute semicircular avicularium on a short rostrum below the aperture, the surface of the zoœcium is granular, and there is a row of pores round the border. There are large, erect, vicarious avicularia, and the mandible has the columella characteristic of the group. The ovicell is a wide open cap, also a generic character. The oral aperture is not so large as in most of the genus, and the operculum has the two ridges turning inwards as in *C. tuberculata*, Busk, *C. jacksoniensis*, Busk, *C. polymorpha*, var. *samboangensis*, Busk, *C. tridenticulata*, Busk, *C. atlantica*, MS. Busk.

There are about 17 tentacles.

It has been overlooked by some authors that Hincks, in 1893, said that he found on re-examination that the *Monoporella albicans*, Hincks, and *Schizoporella aperta*, Hincks, were synonyms.

Loc. Singapore or Philippines (*Hincks*), Andamans (*Th.*), Kalingapatam (*Th.*), Manaar (*Th.*). Ras Osowamembe, Zanzibar Channel (504). Red Sea; Bay of Agig Suraya (21), Khor Dongola (19), Khor Shinab, 10–12 fath. (3), Shukuk, 9 fath. (11), Suez (18), collected by Crossland; Ras el Millan, Sinai coast, and Gimsah Bay, collected by Hartmeyer. Cuba, d'Orbigny coll., Mus. d'Hist nat. Paris, 13782.

Fossil. Bairnsdale, Victoria (*Waters*).

HOLOPORELLA DESCOSTILSII (*Audouin*). (Plate **16.** figs. 1, 2, 3.)

Cellepora Descostilsii, Aud. "Expéd. de l'Égypte," Zool. p. 238, pl. 7. fig. 11; d'Orb. Paléont. Franç. vol. v. p. 401.

Zoarium formed of several layers. Zoœcia coarsely granular, with a few large pores visible in the younger zoœcia. The lower lip is much raised into a narrow ridge, as shown by Savigny.

The large vicarious avicularia stand up erect in many cases, as figured by Savigny, and the border is serrate. The lower edge of the operculum is straight, and the muscular attachments are high up close to the side. The denticle or condyle at each side of the oral aperture can sometimes be distinguished. There is, as a rule, no oral avicularium in the lip, though in looking over considerable pieces I have seen one or two. The mandible of

the vicarious avicularium has the lucida low down, and there is no columella, which occurs in the mandibles of most species of *Holoporella*. The ovicell is a wide open cap (fig. 1), as usual in the genus. The small piece from Ras el Millan has two oral spines, and the oral glands are tubular and more or less contorted.

Loc. "Polyzoa from lamellibranch shells, 30.11.04. Dredged near the quay-wall, Suez" (18), collected by Crossland; Ras el Millan, Red Sea, collected by Hartmeyer.

HOLOPORELLA PIGMENTARIA, sp. nov. (Pl. **15**. figs. 16–19; Pl. **16**. figs. 9–16; Pl. **17**. figs. 22–23.)

The zoarium, formed by several layers of zoœcia, is irregularly mamillate; the surface is very dark or black, though sometimes the raised mamilla is white.

The zoœcia near the growing edge are horizontal, with pores round the border, and the rest of the coarsely granular or nodulated surface is imperforate. A rostrum projecting from the lower lip has a triangular avicularium. There are vicarious avicularia, serrate at the edge, having long spatulate mandibles without a columella. Besides the ordinary pores round the border of the zoœcium, there is a large one belonging to the two neighbouring zoœcia (Pl. **15**. fig. 16). In specimens from Ras el Millan there are also very minute avicularia by the side of the zoœcium (Pl. **17**. figs. 22, *av.*, 23); however, in various species of *Holoporella* these minute avicularia are only seen on a few of the zoœcia, while in others they are general.

There are 17 tentacles, and the glands are tubular, though not so long as in some other species.

This species is much like *Cellepora mamillata*, Busk, and it is separated from it with diffidence, but the operculum spreads out at the base, whereas in *C. mamillata* the operculum, prepared from the type, has the sides nearly straight.

The fact of the zoarium being mamillated is not of primary importance, as there are many species in which the zoœcia are in the same way arranged in regular heaps.

This is a dark species, and a further study of the pigment in *C. vermiformis*, Waters, *C. albirostris*, Smitt, &c., would be of considerable value.

The colour is caused by a quantity of light brown, round cells with minute nucleus near the border. These are found inside the zoœcium near the walls and sometimes a few close up to the tentacular sheath; then they fill the pore-tubes, and on the outer surface of the zoœcium spread from one pore-tube to another, gradually forming a thick layer over a good part of the surface of the zoœcium (Pl. **16**. fig. 16). On the front of the zoœcium the

layer of pigment is situated immediately under the external membrane, and the pigment is also found in the avicularium. The appearance of these pigment-masses is much like that of a piece of old cork. It should not be forgotten that there is a membrane across the bottom and the top of the pore-tube, but yet these pigment-cells occur not only in the pore-tubes but also above and below them.

In the zoœcia without polypides the opercula have near the proximal border a slight projection (Pl. **16.** fig. 10), which is irregular and sometimes grows into a long tube. In one case this long tube has a round body at the end (fig. 12), in another there are projections at various points near the base of this tongue, and then the narrow tube is curled at the end (fig. 13). The commencement of this tongue is by two slight outgrowths of three or four cells; thus at first it is paired.

We have here the commencement of the tentacular sheath, and Harmer * has described the budding polypide of *Flustra papyrea*, Pall., as derived from the two angles of the operculum. In *H. pigmentaria* I have only seen the one case of the earliest stage, but several where the commencement of the tentacular sheath can be recognised, and there are many with the various digitiform processes (fig. 11).

Similar growth occurs in other *Holoporellæ*; and in *Flustra membranaceo-truncata*, Sm., and *Lepralia lonchæa*, Busk, I have seen a tube identical with fig. 12; also in *Schizoporella polystomella*, Reuss, there is in some of the zoœcia a projection or round body by the operculum, which is seen in various stages and commences as a double excrescence. Of course we have to look for these growths in zoœcia where the original polypide has died down and where a fresh growth of polypides is commencing, showing the importance of examining the colonies in all conditions; for specimens which at first seem valueless on account of containing few or no polypides may give valuable information on several points. It is difficult to distinguish between the growing and the reverse or absorbing process, and further examination is here required before we can be quite certain of the interpretation.

Loc. Khor Dongola (2) on *Meleagrina margaritifera*, L., collected by Crossland; Ras el Millan, collected by Hartmeyer; Gimsah Bay, Gulf of Suez, cellected by Hartmeyer; Djibouti (Golf de Badjourah), Récif de Marabout, Red Sea, collected by Mons. Ch. Gravier, who gave me a small piece.

HOLOPORELLA VERMIFORMIS, nov. (Plate **16.** figs. 4–8.)

Zoarium incrusting, darkly pigmented, forming several layers, recumbent at the edges. Zoœcia smooth, with large pores round the border. The base

* "Nature of Excretory Processes," Quart. Journ. Micros. Sc. 1891, p. 138.

of the oral aperture forms a large arc, and the operculum becomes wider at the proximal edge ; on the lower lip to one side there is a small raised avicularium directed laterally and a peristomial fissure ; however, many of the zoœcia have the lower lip entire, without any avicularia, but only a ridge, as in *H. Descostilsii*, Aud. Only a very few vicarious avicularia have been met with, and these have a large nearly semicircular mandible (fig. 5) without columella.

There are columnar processes, usually at right angles to the base of the zoarium, or arising at the side of the zoœcium, and they pass up from a lower layer of zoœcia, though not through a large number of layers as in *H. columnaris*, Busk, nor are they as large.

The oral glands are long and contorted in various directions like a wriggling worm (fig. 7), and on this account the name *vermiformis* is given. The walls of these glands are rather thin, in most cases like the walls of the tentacular sheath, and are without any of the large cells found in the glands of *Schizoporella*, *Smittia*, &c., so that there is no appearance of secreting-cells. The contents of the tube are the yellowish material that we have seen elsewhere.

This is much like the *H. pertusa*, Smitt, but he gives the aperture as 0·31 mm. wide, whereas in the present species it is only about half that width.

However, in the small pieces from the Red Sea given to me by Professor Keller, there was, besides *H. pigmentaria*, nov., a form with large zoœcia and large apertures, which seems to be the *H.* (*Cellepora*) *pertusa* of Smitt, although even here the operculum does not come up to the size given by Smitt, not being more than 0·26 mm. wide. There are very large semicircular avicularia directed inwards over the oral aperture (fig. 18), and also avicularia of various sizes, the mandibles of which have a well-marked columella (Pl. **16.** figs. 17–21).

Loc. From ship 'Fayoum' in Suez docks, 8 months (20).

BERLIN COLLECTION.

CANDA ARACHNOIDES, *Lamouroux*.

In the specimens examined from the Red Sea only two anterior avicularia were found, except those on the ovicells; but I * have already mentioned that in some Australian pieces no avicularia are found, whereas they are common in others. In its zoarial growth it so much resembles *C. retiformis*, Smitt, that we cannot always be sure which of the two some of the older authors had before them, though the characteristic scutum enables *C. retiformis* to be

* Ann. Mag. Nat. Hist. ser. 5, vol. xx. p. 89.

distinguished. The *C. retiformis* from Zanzibar has only a few anterior avicularia, and these are in the neighbourhood of the bifurcation, whereas Miss Philipps mentions them as general along the median line. Smitt did not find any, and in the Japan specimen there are but a few large avicularia with narrow mandibles, in this case also near the bifurcation.

Maplestone says 16 tentacles, and this is the number I find in the Red Sea specimens.

Loc. Australia; Tasmania; New Zealand; Timor; Brazil (fide *Philipps*), Enoshima, nr. Yokohama, Japan (*Waters coll.*); lat. 16° 45′ N., long. 40° 30′ W., collected by Löffler & Siemens; Gimsah Bay, Gulf of Suez, collected by Hartmeyer.

SCRUPOCELLARIA CERVICORNIS, *Busk.*

For synonyms see Miss Jelly's Catalogue, and add:—

Haswell, W. A., "Polyzoa from the Queensland Coast," Proc. Linn. Soc. N. S. Wales, vol. v. p. 37; Meissner, Jena Denk. vol. viii. p. 730; Thornely, "Manaar," p. 109; Records of Indian Mus. vol. i. pt. 3, no. 13, p. 181.

A specimen from Ras el Millan, Red Sea, has the outer spine cervicorn, or at least divided. This is also the case in a specimen from Lizard Island, Queensland, in my collection; on the other hand, in a specimen from Wasin, Brit. East Afriea, there is a very stout spine on each side, and both are usually divided; the anterior and lateral avicularia are small, and the vibracular chambers are longer than in the Red Sea specimen. I do not find the lateral spines by the avicularium, to which Hincks alludes, and doubt whether the species he described was really *cervicornis*.

Loc. Cumberland Island (*Busk*); Victoria (*MacG.*); Queensland (*Hasw. & Wat.*); Gulf of Manaar (*Th.*); Florida, 7–17 fath.; Amboina (*Meissner*); Arabian Sea (*Brit. Mus.*); Ras el Millan, Sinai coast, Red Sea, collected by Hartmeyer; Wasin, Brit. East Africa (522), 20 fath., collected by Crossland.

MEMBRANIPORA TRIFOLIUM, form MINOR, *Hincks.*

Membranipora trifolium, form *minor,* Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vi. (1880) p. 87, pl. 11. fig. 6; *op. cit.* ser. 5, vol. xv. (1885) p. 255, pl. 8. fig. 7; Waters, *op. cit.* ser. 7, vol. xvii. (1906) p. 14.

Membranipora papillata, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 66, pl. 33. fig. 1 (1884).

Loc. Bahia and Tahiti (*Hincks*); Philippine Islands (*Chall.*); Wanganui, Chatham Islands (*Waters*); Singapore (I saw a specimen in Jullien's collection); Um el Jerman, Gulf of Suez, Red Sea, collected by Hartmeyer.

MEMBRANIPORA ARAGOI (*Audouin*).

Flustra Aragoi, Aud. Descrip. de l'Égypte, Hist. nat. p. 240, pl. 10. fig. 1.
Reptescharella Aragoi, d'Orb. Pal. Franç. vol. v. p. 465.

There is a small piece from Gimsah Bay, but in a most unsatisfactory condition, which it has not been possible to clean or preserve properly. There are but few spines, which meet on the central line; they are broad and much flattened out horizontally. The lateral projections over the distal end of the aperture which Savigny figured could not be made out, but apparently the processes in *M. sceletos* *, Busk, from Madeira are very similar. In *sceletos* the spines are compressed instead of being flat, but the two species are apparently related though distinct. Both have large zoœcia.

FARCIMIA OCULATA (*Busk*).

Nellia oculata, Busk, Brit. Mus. Cat. p. 18, pl. 64. fig. 6 & pl. 65 bis, fig. 4 (1852); Thornely, "Manaar," p. 110 (1905); Records of Indian Museum, vol. i. pt. 3, no. 13, p. 185 (1907).
Farcimia oculata, Waters, Ann. Mag. Nat. Hist. ser. 5, vol. xx. (1887) p. 92; MacGillivray, Tert. Poly. Vict. p. 50, pl. 6. figs. 6, 7 (1895).
Cellaria quadrilatera, d'Orb. Pal. Franç. vol. v. p. 29 (1850).
For other synonyms see Miss Jelly's Catalogue.

Miss Jelly in her Catalogue calls this *Farcimia tenella*, Lamk., but with this specific name I cannot agree, seeing that Lamarck only gave a very short description, which might be applied to several species or even genera, as, for instance, *Farcimia* (*Membranipora*) *articulata* †, Waters.

D'Orbigny in Pal. Franç. v. pp. 28, 29, mentions *Cellaria tenella*, Lamk., and also *C. quadrilatera*, d'Orb., and from examination of d'Orbigny's collection I have shown this last to be *F. oculata*, Busk.

There are about 12 tentacles in the Red Sea specimens.

Loc. Florida; off Bahia; Torres Straits; Bass's Straits; Queensland; Victoria; Cape Grenville; Heard Island; Crozet Island; Philippine Islands; Mergui Archipelago; Ceylon; Gaspar Str. and Andamans; lat. 15° N., long. 41° E., 18 fath., collected by Löffler & Siemens; Wasin, Brit. E. Africa, 10 fath.; Prison Island, Ras Osowamembe, and Moweni Bay, Zanzibar, 6 fath., collected by Crossland.

Fossil. Muddy Creek and Wauru Ponds (*Victoria*).

* Waters, "Membraniporidæ," Journ. Linn. Soc., Zool. vol. xxvi. (1898) pl. 49. fig. 2-5.

† Quart. Journ. Geol. Soc. vol. xxxviii. p. 264, pl. 8. figs. 15, 16 (1882). This has since been called *appendiculata* by Hincks, and although he published a long note (Ann. Mag. Nat. Hist. ser. 6, vol. xi. p. 177) maintaining that I was not right in uniting the two species, yet it is clear that Hincks had not correctly appreciated the avicularium. What he figures is the side of the avicularian chamber, while the avicularian opening and mandible are very small, directed right and left of Hincks's figure. MacGillivray recently confirmed my view of the identity of the two species (Tert. Poly. of Victoria, p. 50, pl. 6. fig. 5).

Chaperia tropica, sp. nov. (Plate 17. fig. 1.)

The area occupies about half the front of the zoœcium and the opesial aperture is straight below. At the proximal end of the zoœcium there is a large raised process, dividing at the end laterally in a cervicorn manner, and on the front of this process there is a triangular avicularium. The ovicell is broad, subimmersed.

This seems to belong to the *C. minax* group, and has some relationship with *C. umbonata*, but differs in having the avicularium on the front. It seems nearest allied to *C. cylindracea*, var. *protecta* *, Waters, from the Antarctic, but in that case the process has lateral branches.

Loc. Gimsah Bay, Red Sea, collected by Hartmeyer. Growing on stone.

Microporella Malusii (*Audouin*).

See Miss Jelly's Catalogue and add:—

Reptoporina hexagona, d'Orb. Pal. Franç. vol. v. p. 444. See Waters, Ann. Mag. Nat. Hist. ser. 7, vol. xv. (1905) p. 8.

Although *M. Malusii*, Aud., is so widely distributed I have only come upon one piece in these collections.

Loc. Cosmopolitan. Um el Jerman, Gulf of Suez, on *Retepora jermanensis* nov.

Fossil. In the Tertiaries of Europe, Australia, and Patagonia.

Schizoporella nivea, *Busk*. (Plate 17. figs. 2–4.)

Schizoporella nivea, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 163, pl. 17. fig. 1 (1884); Philipps, "Report on the Polyzoa from the Loyalty Islands, &c.," Willey's Zool. Results, pt. iv. p. 440 (1899); Thornely, "Manaar," p. 114 (1905); Rec. Indian Mus. vol. i. pt. 3, no. 13, p. 189 (1907).

The Red Sea specimens have two very small circular avicularia at the distal corners, and at one of the proximal corners a broad spathulate avicularium. It has not been thought that the presence of this spathulate avicularium necessitates making a new variety, though at one time it was decided to call it var. *millanensis*.

The operculum has the muscular attachments close to the border, and there are faint lines across it. The Red Sea and Manaar specimens have the opercula about one-third smaller than those collected by the 'Challenger.'

There is a specimen from Zanzibar, in many respects like the present, though there is a rostrum below the aperture, and the operculum is longer with a narrow poster. *S. nivea* in many respects is like *S. linearis*, var. *quincuncialis*, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vii. p. 158, pl. ix. fig. 3.

* Résultats du Voy. du S.Y. 'Belgica,' Bryozoa, p. 34, pl. 2. fig. 3.

Loc. S. Africa, 150 fath. (*Chall.*); Noumea, New Caledonia (*Ph.*); Gulf of Manaar (*Th.*); Andamans (*Th.*); Ras el Millan, collected by Hartmeyer.

SCHIZOPORELLA MUCRONATA (*Smitt*).

Hippothoa mucronata, Smitt, 'Floridan Bryozoa,' p. 45, pl. 8. fig. 169.

Schizoporella mucronata, Waters, Ann. Mag. Nat. Hist. ser. 6, vol. iv. p. 10, pl. 2. fig. 9.

The specimen from the Red Sea entirely corresponds with the one I figured from New South Wales.

Loc. Florida (*Sm.*); Green Point, N. S. Wales; Um el Jerman, Gulf of Suez, collected by Hartmeyer.

SCHIZOPORELLA PES ANSERIS (*Smitt*).

Hippothoa pes anseris, Smitt, "Floridan Bryozoa," p. 43, pl. 7. figs. 159, 160.

Mastigophora Dutertrei, var. *pes anseris*, Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. i. p. 77; Thornely, "Manaar," p. 117.

Schizoporella pes anseris, Waters, "Bry. from Madeira," Journ. R. Micr. Soc. (1899), p. 11, pl. 3. figs. 7, 8.

Mastigophora was separated from *Schizoporella* as having vibracula; but this species has avicularia, and therefore I retain it with *Schizoporella*, and it belongs to the *S. Cecilii*, Aud., group.

Loc. W. off Tortugas (*Sm.*); Madeira (*Wat.*); Mauritius (*Kirkp.*); 10 miles off Galle, 34 fath. (*Thornely*); Gimsah Bay, Gulf of Suez, and lat. 16° N., long. 41° W., collected by Hartmeyer.

SCHIZOPORELLA BERNARDII (*Savigny & Audouin*). (Plate **17**. figs. 7–9.)

Cellepora Bernardii, Savigny, Expéd. de l'Égypte, Zool. pl. 7. fig. 7; Audouin, Explication Sommaires Zool. p. 238, p. 64.

Schizoporella depressa, Philipps, "Polyzoa from the Loyalty Isles, &c.," Willey's Zool. Results, pt. iv. p. 445, pl. 42. figs. 6, 6 *a* (1899); (?) Thornely, "Manaar," p. 115.

The zoœcia are irregularly placed, more or less erect, and are ovate with broad radiating ribs. The oral aperture has a broad sinus. The operculum has the muscular attachments distant from the border. There is a small semicircular avicularium at each side of the aperture, and in the older zoœcia a raised ridge encloses a pit in which are the aperture and the avicularia. Occasionally there are one or two of the small avicularia on the distal border; there are a few vicarious avicularia, with duck-bill mandibles, scattered about. The ovicell is not very prominent, rather thrown back, fairly large, with large perforations. The ovicells were not known to Miss Philipps, and Miss Thornely described them as "smooth, hyaline, or ridged, and have an oval area on either side of them." It therefore seems that she must have had another species before her.

Although Savigny did not figure the small round avicularia, he otherwise gave a fair figure showing the ovicell, so that the species is recognisable. Nevertheless it has not been easy to decide which of the two names should be retained.

Loc. Lifu (*Ph.*) ; Gulf of Manaar? and off Mount Lavinia (*Th.*) ; Ras el Millan, collected by Hartmeyer.

GIGANTOPORA FENESTRATA (*Smitt*). (Plate **18.** figs. 17–19.)

Hippothoa fenestrata, Smitt, "Floridan Bryozoa," p. 47, pl. 6. fig. 142 (1872).

Gigantopora lyncoides, Ridley, Proc. Zool. Soc. London, 1881, p. 47, pl. 6. fig. 3; Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. i. (1888) p. 77, pl. 7. fig. 5.

Porina ? columnata, Waters, "Foss. Chil. S.W. Vict.," Quart. Journ. Geol. Soc. vol. xxxvii. (1881) p. 334, pl. 18. fig. 88.

? *Porina tuberculosa*, Maplestone, Proc. Roy. Soc. Vict. n. s. vol. xv. (1902) p. 23, pl. 2. fig. 15.

Porina cribraria, MacGillivray, "Tert. Poly. Vict.," Trans. Roy. Soc. Vict. vol. iv. p. 104, pl. 14. fig. 25 (1895).

Gigantopora fenestrata, Thornely, "Manaar," p. 113 (1905).

The three genera *Gigantopora*, Ridley, *Gephyrophora*, Busk, and *Galeopsis*, Jullien & Calvet, are synonyms, and have been made for species in which two lateral avicularia arch over the oral aperture, forming a bridge and a round or elliptical opening below. However, we have avicularia making an arch in a similar way in *Microporella* and *Smittia*, and it is probably not a character of generic importance ; and, as Kirkpatrick and I have indicated, *Gigantopora* belongs to the Schizoporellidan group ; but when *Schizoporella* is rearranged it is not likely to remain under that genus, though it may be an open question whether it should for the time being be placed there.

The ovicell is but very little raised and decumbent by the peristome. In *G. polymorpha*, Busk, the position of the ovicell is not usually indicated. The operculum of the *G. fenestrata* is about the size of that of *G. polymorpha* and is straighter at the proximal edge. It is double, consisting of two similar separable membranes one over the other; but as there is only one small cylindrical specimen, I have not been able to make full examination.

G. fenestrata is closely related to the Italian Tertiary fossil *Porina? duplicata* *, Reuss, which, however, has only an avicularium at one side—in fact, a large number of zoœcia have none, and when it exists it is more in the lip than is the case in the present species ; also the peristome in the fossil is more raised, and the ovicell is somewhat more distinct and narrower.

Loc. Florida, 17 fath. (*Sm.*) ; S.E. Brazil, 33 fath. (*Ridley*) ; Mauritius (*Kirkp.*) ; Red Sea, lat. 16° 45′ N., long. 40° 30′ W., 26 fath., collected by Löffler & Siemens ; Gulf of Manaar (*Th.*).

Fossil. Victoria, Australia.

* Waters, "North Italian Bryozoa," Quart. Journ. Geol. Soc. vol. xlvii. p. 25, pl. 3. fig. 14.

LEPRALIA MONTFERRANDI (*Audouin & Savigny*). (Plate **17.** figs. 15–18.)

Flustra Montferrandi, Aud. "Descript. de l'Égypte," Hist. nat. vol. i. p. 240, pl. 9. fig. 14.

Lepralia Mortoni, Haswell, "Polyzoa from Queensland Coast," Proc. Linn. Soc. N.S. Wales, vol. v. (1881) p. 40; Thornely, "Manaar," p. 119.

? *Lepralia obtusata,* Ortmann, "Die Japanische Bryozoen," Arch. f. Naturgesch. p. 41, pl. 3. fig. 13 (1890).

The zoœcia are not much raised, and below the aperture there is a minute triangular avicularium. However, this in a few cases, both from the Red Sea and from Manaar, develops into a large spathulate avicularium. The operculum has a dark thick border, and the poster is formed of a large arc of a circle. The ovicell is closed by the operculum.

The margins of the aperture are not much raised, but there are specimens in the Manaar collections with a decidedly raised peristome and similar avicularia, though with large pores round the border of the zoœcia instead of the uniform perforations. This form, which may have to receive another generic name, also occurs from New Zealand (A. W. W. coll.). It is scarcely necessary to say that *L. Montferrandi* is only placed provisionally with *Lepralia*, and it would fall under *Cribrella*, Jullien & Calvet, if we are to accept that genus as based upon satisfactory characters. It belongs to the *Lepralia galeata* group, but is much smaller than the species described from Chili in my 'Belgica' Antarctic Report, p. 48. Probably one or two genera with nearly round apertures will have to be separated from *Lepralia.*

This species I have from Japan; it has the size and shape of the operculum identically the same as in the Red Sea specimens, also those from Manaar are within a trifle the same size. The *Lepralia acuta*, Ort., *L. obtusata*, Ort., and *Schizoporella pellucida* *, Ort., all seem most closely related and require further study. The *Lepralia cribrosa*, Maplestone (fossil, Victoria, Australia), differs from *L. Montferrandi* in having an avicularium.

Loc. Holborn Island, Queensland; Enoshima Island, N. Yokohama, Japan (*A. W. W. coll.*); Gulf of Manaar; Trincomalee, East Cheval Paar (*Th.*); Ras el Millan, coll. by Hartmeyer.

LEPRALIA LONCHÆA, *Busk.*

Lepralia lonchœa, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 146, woodcut, fig. 43 (1884); Waters, Zool. Chall. Exp. vol. xxxi. pt. lxxix. p. 28 (1889); Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. v. (1890) p. 19.

Lepralia vestita, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xv. (1885) p. 256, pl. 9. fig. 9; Waters, *op. cit.* ser. 5, vol. xx. (1887) p. 194, pl. 6. fig. 21, & ser. 6, vol. iv. (1889) p. 12, pl. 1. fig. 20.

This was first described by Busk in the 'Challenger' Report without figures, except of the operculum and mandible. In my supplementary Report

* There is *S. pellucida* of MacGillivray.

I said this was probably *vestita*, Hincks, but material was not available to speak with certainty, though since then Kirkpatrick has stated that examination proves them to be identical. There is strong probability that this is *Cellepora Mangnevilla* of Audouin-Savigny; but we cannot be absolutely sure, though the avicularia stand up against the peristome, which in one case is shown expanded. The name, however, was wrongly used, as it certainly is not the *Cellepora Mangnevillana* of Lamouroux. On this account d'Orbigny * gave Audouin's species a new name—*Audouinii*; therefore Busk was wrong when he called a Madeira form *Mangnevilla*, as he should have said *Audouinii*; but since then I have shown that this Madeira species was not the one described by Audouin, and have called it *Lepralia peristomata* †, the oral aperture of which is about half the size of that of *L. lonchæa*. Smitt has also described from Florida a *Lepralia* as *L. Audouinii*, d'Orb.‡, and here the size of the aperture is about the same as that of *L. lonchæa*. There is, however, no peristomial elevation or avicularia and the ovicell is somewhat different, but it closely resembles what I have called *L. vestita*, var. *australis*.

The Red Sea specimens are similar in size and in other respects to those from Tahiti described by Hincks. There is a round opening in the membrane under the mandible.

Loc. Admiralty Island, lat. 2° 0′ S., long. 147° 20′ E. (*Busk*) ; Tahiti, Fiji (*Hincks*) ; Tizard Reef, China Seas (*Kirkp.*) ; Ras el Millan, Sinai Coast, collected by Hartmeyer.

Lepralia. (Plate **17.** fig. 21.)

The figure shows the primary zoœcia of a *Lepralia* which cannot at present be determined, *though*, as the three primary zoœcia occurring together in this way is unusual, it will probably be identified on some future occasion.

Loc. Ras el Millan, on *Thalamoporella*.

Lagenipora ? tuberculata, *MacGillivray*.

Lagenipora tuberculata, MacG. Prod. Zool. Vict. dec. xvi. p. 209, pl. 156. figs. 1, 2.

The small specimen is not well preserved and is difficult to study, but the "verruco-spinous" surface is similar to that of *L. tuberculata*, MacG., and *Anarthropora horrida*, Kirkp., from Mauritius. The pores on the surface have a protecting projection over one side. These, however, do not occur on all the pores in the Red Sea specimen, and are not so large as in those from Australia. In some British Museum specimens the projection is often

* Pal. Franç. vol. v. p. 401 (1850–52).

† Journ. Roy. Micr. Soc. 1899, p. 10, pl. 3. fig. 20.

‡ 'Floridan Bryozoa,' p. 56, pl. 11. fig. 211 (1873).

acuminate at the end, reminding us of the peristome of *Lichenopora*: sometimes these are thin like the point of a knife, in others they are much more solid, though not forming a continuous tube. This Red Sea form is closely allied to the *Anarthropora horrida*, Kirkp.; but in that species the zoœcia are smaller, the pores are more numerous, and there is a narrow lateral avicularium. Both belong to the same genus, but the material is not sufficient for a discussion of this point. *Lagenipora*, as I now understand it, has an ovicell below the peristome, with a flat perforated area. However, in the species now mentioned the ovicells are unknown, so that we can only leave it provisionally under *Lagenipora*, to await further examination.

Loc. Victoria (*MacG.*); Gimsah Bay, collected by Hartmeyer.

SMITTIA NITIDA (*Verrill*). (Plate **17**. figs. 19, 20.)

[*Discopora nitida*, Verrill, Amer. Journ. Sc. ix. (1875) p. 415, pl. 7. fig. 3.

There has been some confusion over *S. nitida*, V., and several of us must plead guilty to an undue tendency to make varieties round a few species, before various characters were sufficiently understood. In the British Museum there are some good specimens sent by Verrill as *nitida*, though some other species, some of which were not even *Smittia*, had been inadvertently included. It has the square cells as figured by Verrill, a nearly round oral aperture, with a peristome somewhat raised at each side, two oral spines, and either a small avicularium rounded and expanded at the extremity, or in some zoœcia a stout triangular avicularium also directed downwards. Some specimens examined since fig. 19 was drawn have ovicells which are large and raised, with a central area in which are large pores—that is, they are of the *trispinosa* type, being much like those shown on Pl. **17**. fig. 5.

Loc. Long Island Sound (*Verrill*); Ras el Millan, collected by Hartmeyer; and lat. 16° N., long. 41° W., 30 fath., collected by Löffler & Siemens.

SMITTIA TRISPINOSA, var. PROTECTA, *Thornely*. (Plate **17**. figs. 5, 6.)

Smittia trispinosa, var. *protecta*, Thornely, "Manaar," p. 123 (1905).
Smittia nitida, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. vii. (1881) p. 159, pl. 9. fig. 5.

The zoœcia in the Red Sea specimens are arranged fairly regularly, not heaped. There are two spines above the oral aperture, and the ovicells are large, wide, raised, with but a rather small area perforated by irregular pores, which are often large. In the Red Sea specimens the large duck-bill avicularia are not common, and are much smaller than those in the specimens from Manaar. These avicularia are the more highly-developed equivalent of the small blunt avicularia, and in these large avicularia the round sub-

mandibular portion and the mandibular part are in quite different planes. The mandible is divided at the end into three or four points.

Loc. Gulf of Manaar (*Th.*) ; Ras el Millan, collected by Hartmeyer.

SMITTIA TROPICA, sp. nov. (Plate **17.** figs. 10–14.)

Zoarium white, incrusting. The zoœcia are distinctly separated, and there are pores at each side of the nearly straight borders. The surface is nodulated, and there are two oral spines. The peristome is much raised, sometimes dentate, but always with two internal ridges passing down the peristome and terminating in cardellæ. There is at one or both sides near the aperture an avicularium directed downwards. In most cases the avicularium is linear to oblong, with a thin transparent mandible (fig. 12) ; in other cases there is a somewhat larger avicularium, beaked at each side, and these larger triangular avicularia have a dark thick acute mandible (fig. 11), and here the muscles are four or five times as large as those of the first mentioned thin linear avicularia. In the narrow avicularia there is an opening on each side of the bar as usual, but there is also a small round opening further removed distally from the bar (fig. 14). The distal end of the avicularium means the beak end.

The ovicell is small, globular, thrown back, perforated, and closed by an ovicellular operculum (fig. 13, *o.o.*), which is semicircular and about half the size of the oral operculum. The ovicell is formed by two layers, and pore-tubes pass from one to the other (fig. 13). There are minute oral glands and 13 tentacles.

This very probably is the *Smittia trispinosa* form *spathulata*, Hincks *, but it is not the *spathulata* of MacGillivray.

Loc. Ras el Millan, collected by Hartmeyer.

LAGENIPORA COSTAZII (*Audouin*).

Cellepora Costazii, Aud. "Descrip. de l'Égypte," p. 237, pl. 7. fig. 4.

There is a small specimen in poor condition from Gimsah Bay, in which no ovicells or avicularia are preserved. It, however, seems to correspond with some British and Mediterranean specimens.

[In consequence of the remark of a friend, I have again examined the British Museum specimens of *Lagenipora socialis*, Hincks, and the collections of Hincks and Busk have been added since I first wrote on the group. The type-specimen of Hincks shows three ovicells, which are situated at the back, that is the neural wall of the tubular peristome. The peristome is raised above the ovicell, and there is a distinct area on the ovicell with some pores,

* Ann. Mag. Nat. Hist. ser. 5, vol. xix. p. 304, pl. 9. fig. 3.

but these are not readily made out. A specimen in my collection from Hastings, sent to me by Miss Jelly, and therefore to be considered as a co-type, has one such ovicell. It is therefore now quite clear that I was right in removing from *Cellepora* to *Lagenipora* a group with this form of ovicell; and *Lagenipora* must include *Cellepora Costazii*, Aud., *C. granum*, Hincks, &c. This is dealt with in my paper on Bryozoa from Madeira, Journ. R. Micr. Soc. 1899, p. 13.—16*th October*, 1908. A. W. W.]

RETEPORA HIRSUTA, *Busk*. (Plate **18**. figs. 24–26.)

Retepora hirsuta, Busk, Zool. Chall. Exp. vol. x. pt. xxx. p. 119, pl. 26. fig. 4 & woodcut, fig. 29 (1884).

The zoarium is more or less cup- or perhaps saucer-shaped; the fenestra are small, about the width of the branches. The zoœcia are distinct, with smooth surface and a few pores at the side. The peristome rises at the sides, and sometimes quite meets, forming a pore. In one or two cases there is an avicularium in the peristome, but this is rare, and it is also very rare to find any small avicularia on the anterior surface. Busk figures numerous avicularia, but they do not occur in my 'Challenger' specimen. The oral aperture has a small sinus, but a corresponding projection is not found on the operculum, as the sinus is formed by the double ridge within the peristome, to which I have referred as occurring in various *Reteporæ* and some *Smittiæ*.

There are some avicularia in the fenestræ, and sometimes also on the anterior wall of the zoœcium, in which the end is divided and raised. This kind of bifid avicularium is frequent in the *monilifera*-group.

The spines are thin and smooth, and this is also usually the case in the 'Challenger' specimen already referred to, though in that they are sometimes much stouter; and also in the specimen mentioned there are only two oral spines, whereas Busk gives five. However, in my 'Challenger' specimen although most of the spines are smooth, one is antenniform as described by Busk, who considered it as characteristic of the species. Thus we see what a difficult section of *Retepora* this is, as many of the characters are only seen in isolated cases. The ovicell is of the *monilifera* type with the stigma very wide, both in the median and curved lower portion, and there is sometimes a small semicircular avicularium near the distal end of the ovicell. There are 11 tentacles.

This species is very much like *R. monilifera*, var. *umbonata*, MacG., and perhaps that name should be used. The Australian specimens of var. *umbonata* are much stouter, and have semicircular or ovate avicularia surrounding the fenestræ as well as the bifid form.

Loc. Cape York, Torres Straits, Stat. 186 (*Chall.*); Red Sea, lat. 16° N., long. 41° W., 30 fath., collected by Löffler & Siemens; Zanzibar (*Crossland*).

Retepora abyssinica, sp. nov. (Plate **18**. figs. 1–10.)

Zoarium branched in one plane, not reticulated, branches thick. The size of the zoarium may exceed 40 mm. The central zoœcia have large avicularia on a raised chamber, and with the end raised and sometimes bifid, directed laterally or downwards. The mandibles are broadly triangular (fig. 5). The labial pore is distinct and the fissure is well-marked. The ovicells are cucullate, with a slit in a thinner median part of the ovicell ; and the ovicell-wall is prolonged downwards into the oral aperture by a subtruncate lamina, looking just like a uvula, and this structure, which occurs in some other species, is referred to in my paper on *Retepora*, Journ. Linn. Soc., Zool. vol. xxv. p. 260.

The dorsal surface has vibices, and in the area thus formed there is a long narrow avicularium with the mandible pointing downwards (fig. 6).

In the older part of the zoarium (fig. 9) the aperture is depressed, and there are stout vibices passing diagonally from aperture to aperture ; the peristome has a suboral notch, and at the side of this there is a small avicularium which sometimes is circular, at others elongate and distinctly bifid at the end (fig. 10), but well within the aperture.

The are about 13 tentacles.

This species in general appearance so closely resembles *R. Solanderia* *, Risso, that at first it was taken for that species; but, besides other differences, the dorsal avicularia, instead of being directed diagonally upwards and having the same shaped mandibles as the anterior, are directed straight downwards and have a narrow mandible. Calvet † describes *R. Solanderia* from Corsica and figures the operculum, which differs entirely from that of the present form, and is similar to that of *Cellepora coronopus*, S. Woods, and so unlike the operculum of any *Retepora* as to be a considerable puzzle.

Thus *R. abyssinica* is much like the fossil *R. coriensis* of MacGillivray ‡, and there are points recalling *R. gigantea*, Busk, from which, however, it is distinct. It also is very closely allied to *R. marsupiata*, Smitt, and further material may possibly show that it should be called *marsupiata*.

Loc. Red Sea, lat. 16° N., long. 41° W., 30 fath., collected by Löffler & Siemens.

Retepora jermanensis, sp. nov. (Plate **18**. figs. 11–16.)

Zoarium small, cup-shaped (15–20 mm. across), with very small fenestræ. The labial sinus is quite at one side, and in the lip there is a fairly large triangular avicularium, while about the middle of the surface of the zoœcium

* See Waters, Journ. Linn. Soc., Zool. vol. xxv. (1895) p. 264.

† "Bry. Marins des côtes de Corse," Trav. de l'Inst. de Zool. de l'Univ. de Montpellier, ser. 2, Mém. xii. p. 35, pl. 2. figs. 5–8.

‡ 'Tert. Polyzoa of Victoria,' p. 116, pl. 15. fig. 19.

there is a small semicircular one. The surface is tubercular, the tubercles being very few, so that it cannot be called granular. The ovicell has a fissure in front, and the lamina extends into the oral aperture like a uvula, as already described in other species.

On the dorsal surface there are numerous vibices with but few avicularia.

This is a much more delicate species than *R. granulata*, MacG., the branches not being half the width, with the tubercles more distinct, also the operculum is not so wide and the ovicell differs, having a projecting plate.

There are 11 tentacles.

Loc. Ras el Millan and Um el Jerman, Red Sea, collected by Hartmeyer; Prison Island, Zanzibar Channel (513), on the shore, collected by Crossland.

[At the last moment I have received from Mr. Crossland some shells of *Margaritifera vulgaris* collected at Khor Dongonab. Incrusting them is one colony of *Porella nitidissima*, Hincks, known from Madeira and Mauritius, also *Smittia trispinosa*, Johnst., not recorded previously; besides these, *Smittia egyptiaca*, Waters, *Thalamoporella Rozierii*, Aud., and *Ætea recta*, Hincks, are abundant.—10*th February*, 1909. A. W. W.]

EXPLANATION OF THE PLATES.

Plate 10.

Fig. 1. *Vittaticella Contei*, Aud. Anterior surface, × 85. From Khor Dongola.
2. Do. do. Dorsal surface, × 85.
3. Do. do. Operculum, × 250.
4. Do. do. Natural size.
5. *Scrupocellaria Jolloisii*, Aud. Anterior surface, × 25. Suez, among corals.
6. Do. do. Dorsal surface, × 25.
7. Do. do. Mandible, × 85.
8. Do. do. Vibraculum, × 85.
9. Do. do. Natural size.
10. Do. do. Section showing dark bodies by the side of the zoœcium, × 50. From Ras el Millan.
11. *Scrupocellaria serrata*, sp. nov. Anterior surface showing avicularia by the side of the zoœcium, × 25. From Suez.
12. Do. do. × 25.
13. Do. do. Dorsal surface, × 85.
14. Do. do. Mandible, × 85.
15. *Scrupocellaria mansueta*, nov. × 25. (*a*) Avicularium, × 85. From Suez Bay.

Plate 11.

Fig. 1. *Bugula neritina*, L. × 25. Showing the growth of the small fleshy mass at the inner side of the zoœcinm, and from this the gradual development of the ovicell. From Suez.
2. Do. do. Detached ovicell, × 50.
3. Do. do. Zoarium seen from the side, showing the ovicells. × 25.

Fig. 4. *Bugula neritina*, var. *minima*, nov. Dorsal surface, × 25. From Khor Dongola.
5. Do. do. Anterior surface, × 50.
6. Do. do. Anterior surface, × 50. From Nersa Makdah.
7. Do. do. Mandible, × 85.
8. *Membranipora Savartii*, Aud. Distal rosette-plates, × 25.
Figs. 9, 10. Do. do. Natural size. From Khor Dongola.
Fig. 11. Do. do. × 25. Young zoœcia. From Suakim.
12. Do. do. × 25. Older zoœcia showing small proximal denticles.
13. Do. do. × 25. From Red Sea, lat. 16° N., 41° W.

Plate 12.

Fig. 1. *Membranipora limosa*, sp. nov. Prepared with Eau de Javelle. × 25. From Khor Shinab (3).
2. Do. do. Natural size.
3. Do. do. × 12. Without the membrane being removed. Shows the thickened walls and elongate zoœcia at the bifurcation.
4. Do. do. Transverse section decalcified, × 12.
5. Do. do. Operculum, × 85.
6. *Microporella coronata*, Aud. × 50. From Suez Docks (20).
7. Do. do. × 25.
8. Do. do. Mandible, × 85.
9. Do. do. Operculum, × 85.
10. *Membranipora bursaria*, MacG. Operculum, × 85. From Engineer Island.
11. *Schizoporella unicornis*, var. × 25. Showing the diagonal position of the zoœcia. From s.s. 'Thyra' from the Mediterranean, docked in Suez (9).
12. *Schizoporella unicornis*, Johnst. Operculum, × 85.
13. Do. do. Mandible, × 85.
14. *Rhynchozoon corrugatum*, Thornely. × 85. From the Gulf of Suez, in the Busk Collection in the British Museum.
15. Do. do. × 25. From Suez Canal (14).
16. Do. do. Operculum, × 85.
17. *Schizoporella argentea*, Hincks. Mandible, × 85. From (2).
18. Do. do. Operculum, × 85.

Plate 13.

Fig. 1. *Schizoporella viridis*, Thornely. × 25. From Khor Dongola.
2. Do. do. × 25. Showing the zoœcia irregularly heaped, and one complete ovicell, also one in course of formation in which the two calcareous walls are distinguished.
3. Do. do. Oral aperture, × 85.
4. Do. do. Mandible of vicarious avicularium, × 85.
5. Do. do. Mandible of small avicularium, × 250; *a* × 85.
6. Do. do. Operculum, × 85.
7. Do. do. Aperture of the ovicell, × 85.
8. Do. do. Ovum in ovicell, × 85.
9. *Smittia marmorea*, Hincks. × 50. From Suez (14).
10. *Lepralia japonica*, Busk. Shows ovicells and one broken-down ovicell, × 25. From Shukuk.
11. Do. do. Mandible, × 85.
12. Do. do. Operculum, × 85.

Fig. 13. *Lepralia robusta*, Hincks. Mandible, × 85. From Khor Dongola.
14. Do. do. Operculum, × 85.
15. *Lepralia occlusa*, Busk. Mandible, × 85. From Suez.
igs. 16, 17. *Schizoporella argentea*, Hincks. × 85 & 25. From Khor Dongola.

PLATE 14.

Fig. 1. *Lepralia occlusa*, Busk. × 25. From Agig Suraya (21).
2. Do. do. × 50.
. Do. do. Transverse section showing the lobulated glands (*gl*) at the base of the zoœcium. (*op*) operculum, (*ts*) tentacles. × 85.
4. Do. do. Section of the duct or reservoir, × 250.
5. Do. do. Longitudinal section through the broader axis of the zoarium, showing the lobulated glands (*gl*) and the ducts in section in the lowest middle zœcium, × 85.
6. Do. do. Showing gland (*gl*) and reservoir (*r*), × 250. From Wasin, Brit. East Africa (501). The state of preservation of this was not entirely satisfactory.
7. Do. do. Longitudinal section cut through the shorter axis, showing the gland (*gl*), reservoir (*r*), diaphragm (*d*), operculum (*op*). × 85.
8. Do. do. Showing lobulated gland and the muscles by which it is attached, × 250.
9. Do. do. Longitudinal section through a lobulated gland, × 250.
10. *Lepralia eliminata*, Waters. Longitudinal section showing pair of glands, × 85.
11. Do. do. × 250.
12. *Cellepora caminata*, Waters. Tubular ramified gland, × 250.
13. *Lepralia occlusa*, Busk. Glands and ducts shown diagrammatically.
14. *Porella saccata*, Busk.* The interior of a portion in which there are no polypides, showing the glands reduced to two small globes attached to the fleshy tissue. × 85. From Franz Josef Land.

PLATE 15.

Fig. 1. *Lepralia cucullata*, Busk, × 50. From Suez (2).
2. Do. do. Section of aperture with (*op*) operculum open, (*sh*) front walls of zoœcium, (*t*) tentacles, (*ts*) tentacle-sheath, (*cs*) compensation sac, (*k*) knob on operculum. × 85. From Naples.
3. Do. do. Aperture with operculum nearly closed. (*d*) diaphragm. × 85. From Naples.
4. Do. do. Transverse section of a zoœcium near the distal end, showing the larva near the base of the zoœcium. × 85.
5. Do. do. Operculum, × 85.
6. *Smittia egyptiaca*, sp. nov., × 50. From Khor Dongola (19).
7. Do. do. var. *heteroopolita*, nov., × 50. From Suez (14).
8. Do. do. Operculum, × 85.
9. Do. do. Dorsal surface, showing the zoœcia in biserial rows, × about 10.
10. *Lepralia cucullata*, Busk. Commencement of glands growing on the operculum, × 250. From Suez.

* This also shows the avicularian chamber, in which there are two very long muscles, and at the base there are the two characteristic pores. It would seem as if the avicularian chamber could take the place of a compensation-sac.

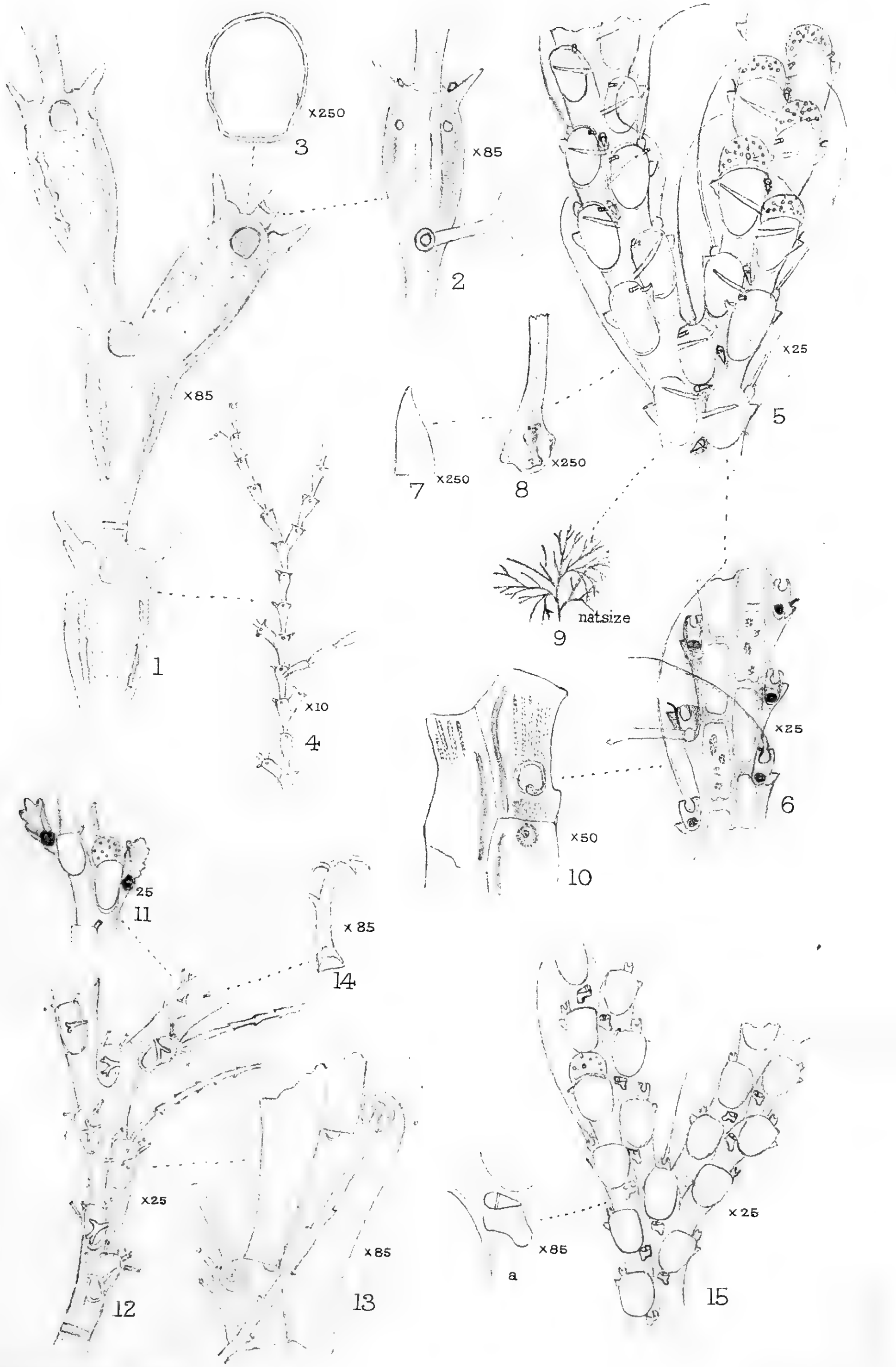
Fig. 11. *Smittia protecta*, Thornely. Polypide removed from the zooecium, showing the small oral glands (*g*), the diaphragm (*d*), and the tentacles (*t*). × 85.
12. *Thalamoporella Rozierii*, Aud., × 25. From Ras el Millan.
13. Do. do. Vicarious avicularian chamber, × 50.
14. *Thalamoporella Rozierii*, Aud. Section of ovicell showing two larvæ, of which the right one is clearly older than the left.
15. Do. do. Mandible, × 85. From Ras el Millan.
16. *Holoporella pigmentaria*, sp. nov., × 85. From Khor Dongola.
17. Do. do. Operculum, × 85.
Figs. 18, 19. Do. do. Mandibles, × 250.

Plate 16.

Fig. 1. *Holoporella Descostilsii*, Aud., × 50. (*ov*) ovicell. From Suez.
2. Do. do. Mandible, × 85.
3. Do. do. Operculum, × 85.
4. *Holoporella vermiformis*, sp. nov., × 50. From Suez (20).
5. Do. do. Mandibles, × 85.
6. Do. do. Operculum, × 85.
7. Do. do. Oral glands, × 85.
8. Do. do. Transverse section of oral gland, showing mesenchym-cells (*m*) on the wall of the sac and the homogeneous contents (*hc*) within the sac. × 50.
9. *Holoporella pigmentaria*, sp. nov., × 50. From Khor Dongola.
10. Do. do. Distal end of operculum; double outgrowth of cells to form tentacular sheath, × 300. From Khor Dongola.
11. Do. do. Distal end of operculum with digitiform process, × 300. From Khor Dongola.
2. Do. do. Distal end of operculum with tubular outgrowth and dark body at the end, × 300. From Ras el Millan.
13. Do. do. Operculum, showing the growth from the distal end, × 250. From Ras el Millan.
14. Do. do. Mass of cells causing the dark colour, × 25. From Khor Dongola.
15. Do. do. Cells more magnified.
16. Do. do. Showing how the brown-coloured mass spreads from the pore-tubes, first to the neighbouring ones and then over the whole of the front. × 50.
17. *Holoporella pertusa*, Smitt. Operculum, × 85. Red Sea.
Figs. 18, 19, 20, 21. Do. do. Mandibles, × 85.

Plate 17.

Fig. 1. *Chaperia tropica*, sp. nov., × 25. From Gimsah Bay.
2. *Schizoporella nivea*, Busk. Mandible, × 85.
3. Do. do. Operculum, × 85.
4. Do. do. × 25. From Ras el Millan.
5. *Smittia trispinosa*, var. *protecta*, Thornely, × 25. From Ras el Millan.
6. Do. do. do. Mandible, × 85.
7. *Schizoporella Bernardii*, Sav. & Aud., × 25. From Ras el Millan.
8. Do. do. Operculum, × 85.
9 Do. do. Mandibles, × 250.
10. *Smittia tropica*, sp. nov., × 25. From Ras el Millan. Showing the two kinds of avicularia.



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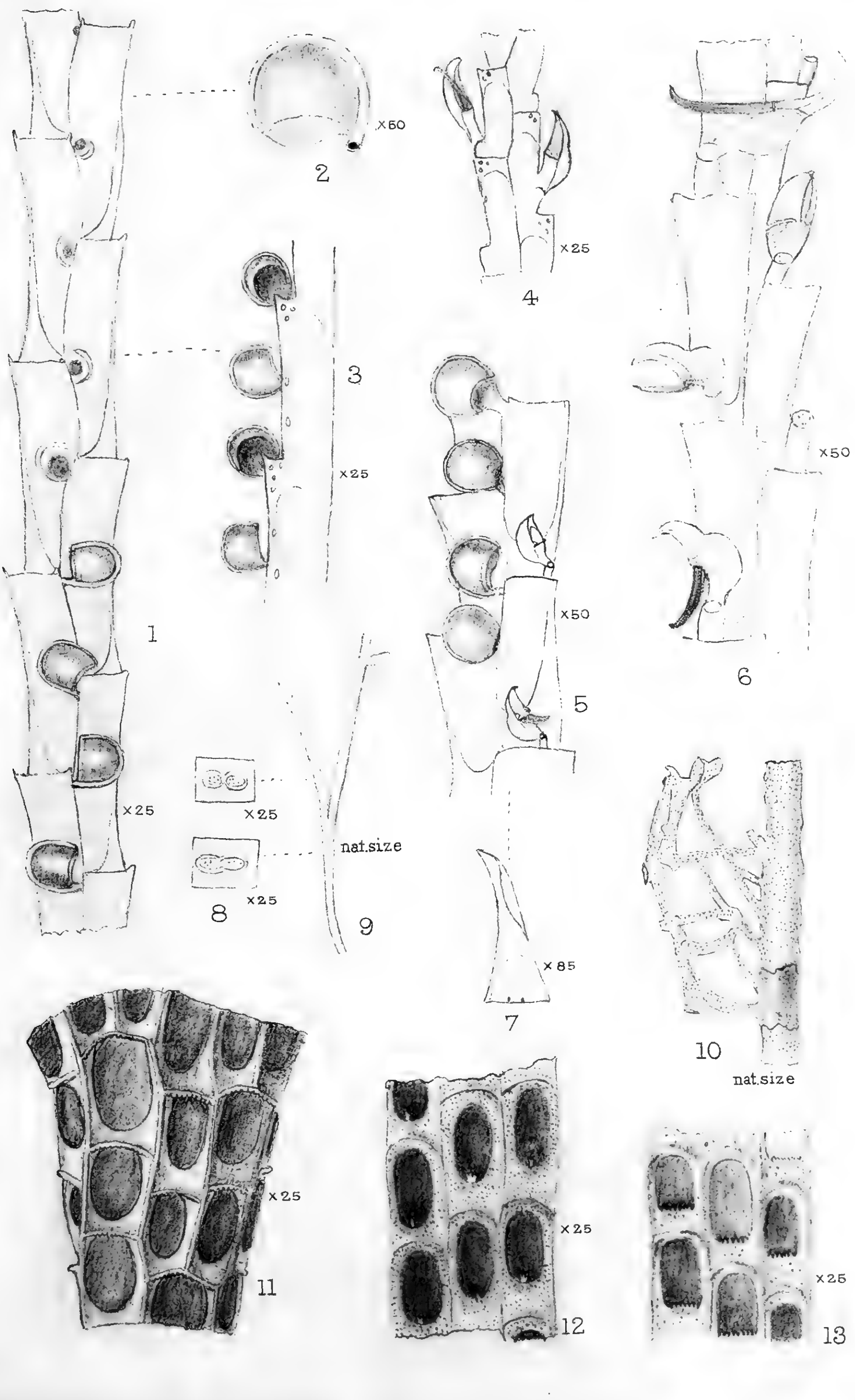

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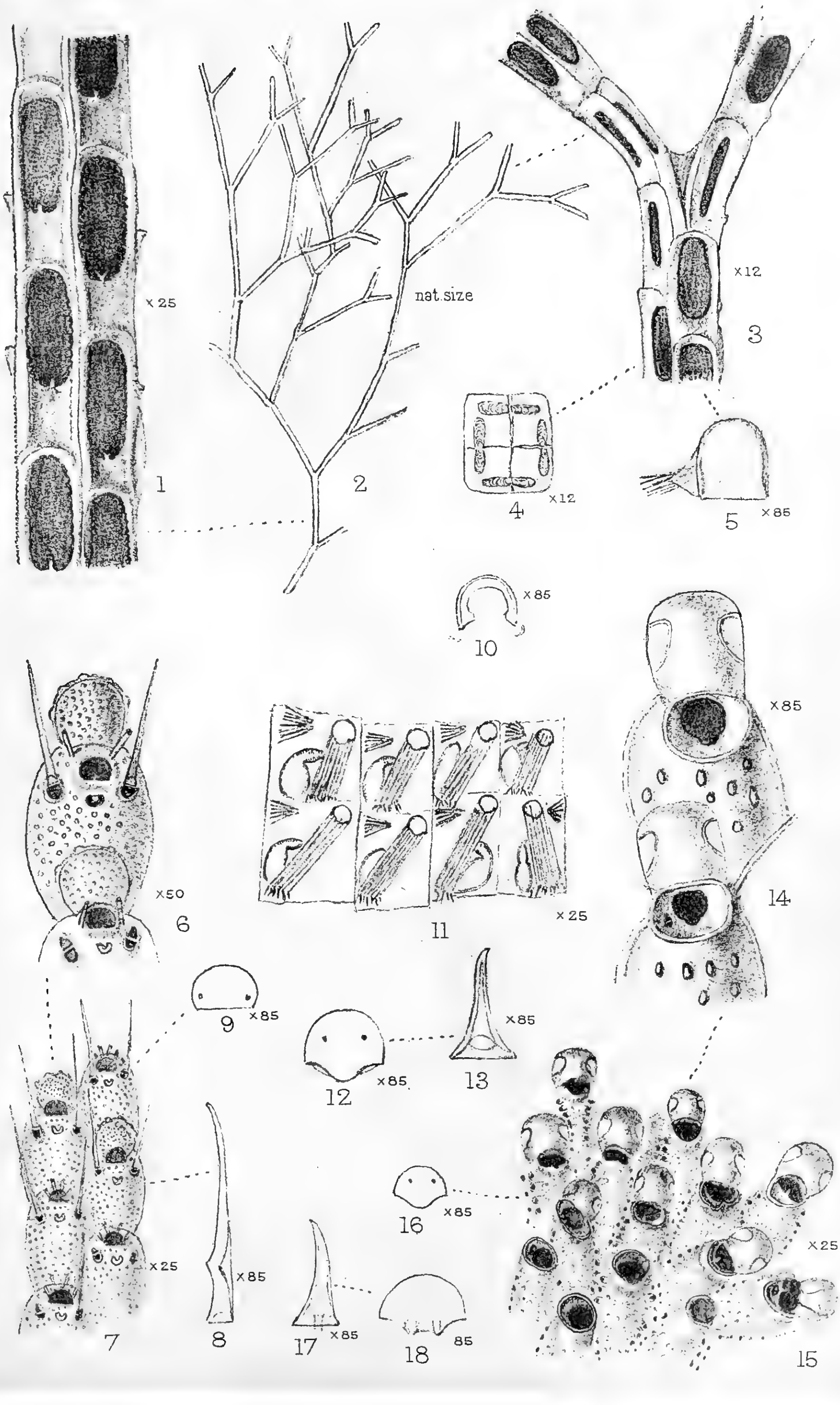

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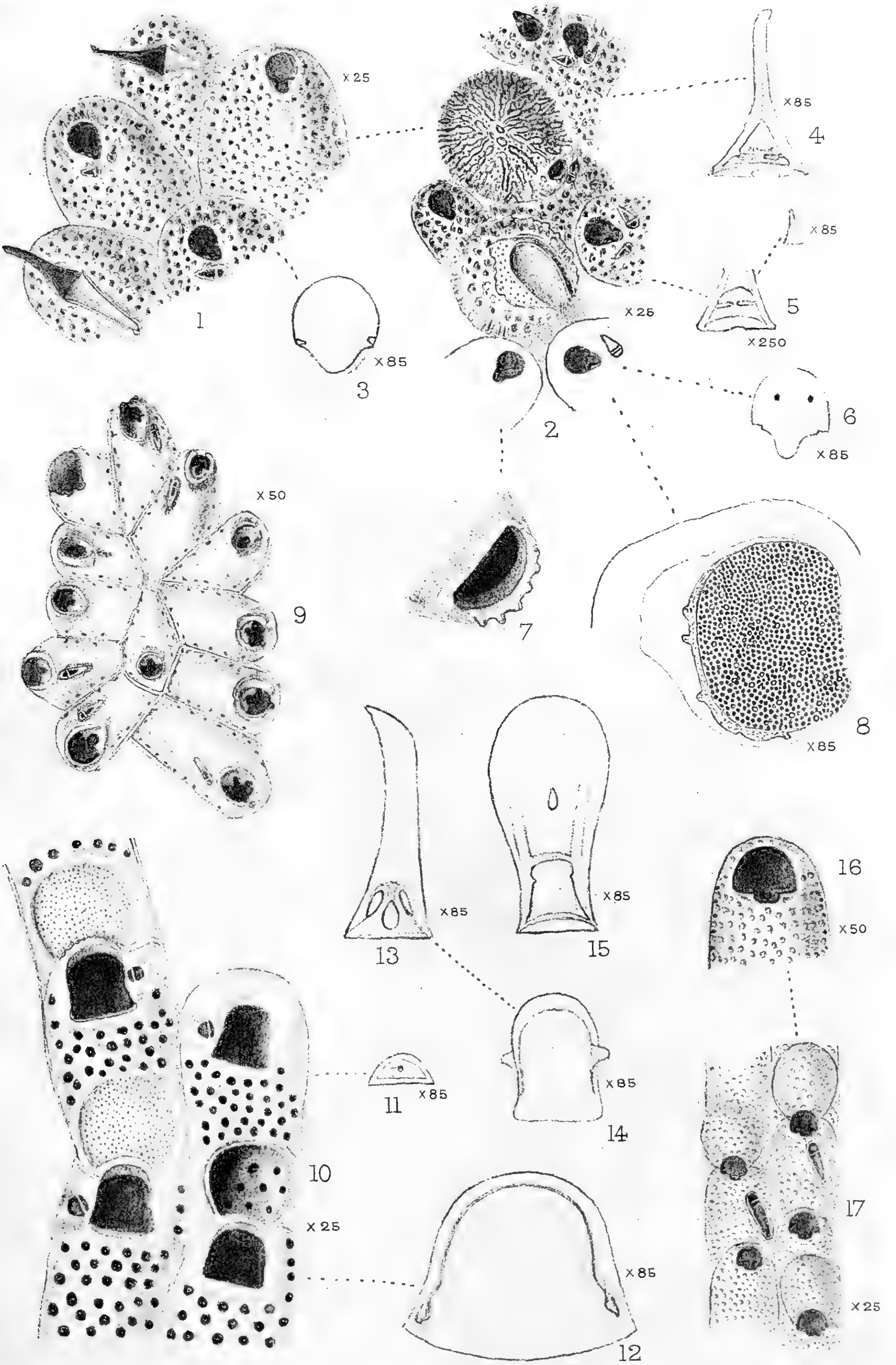

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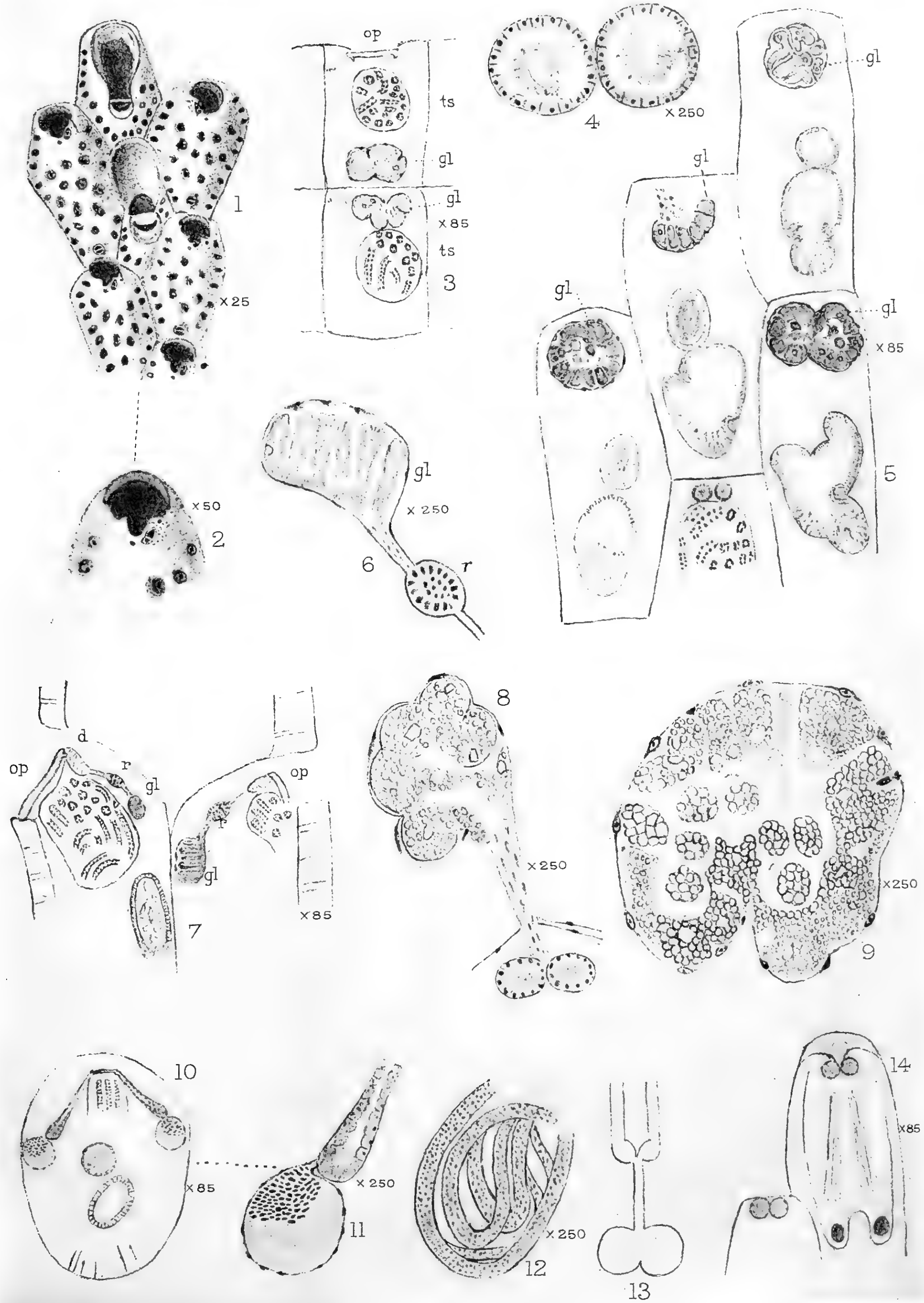

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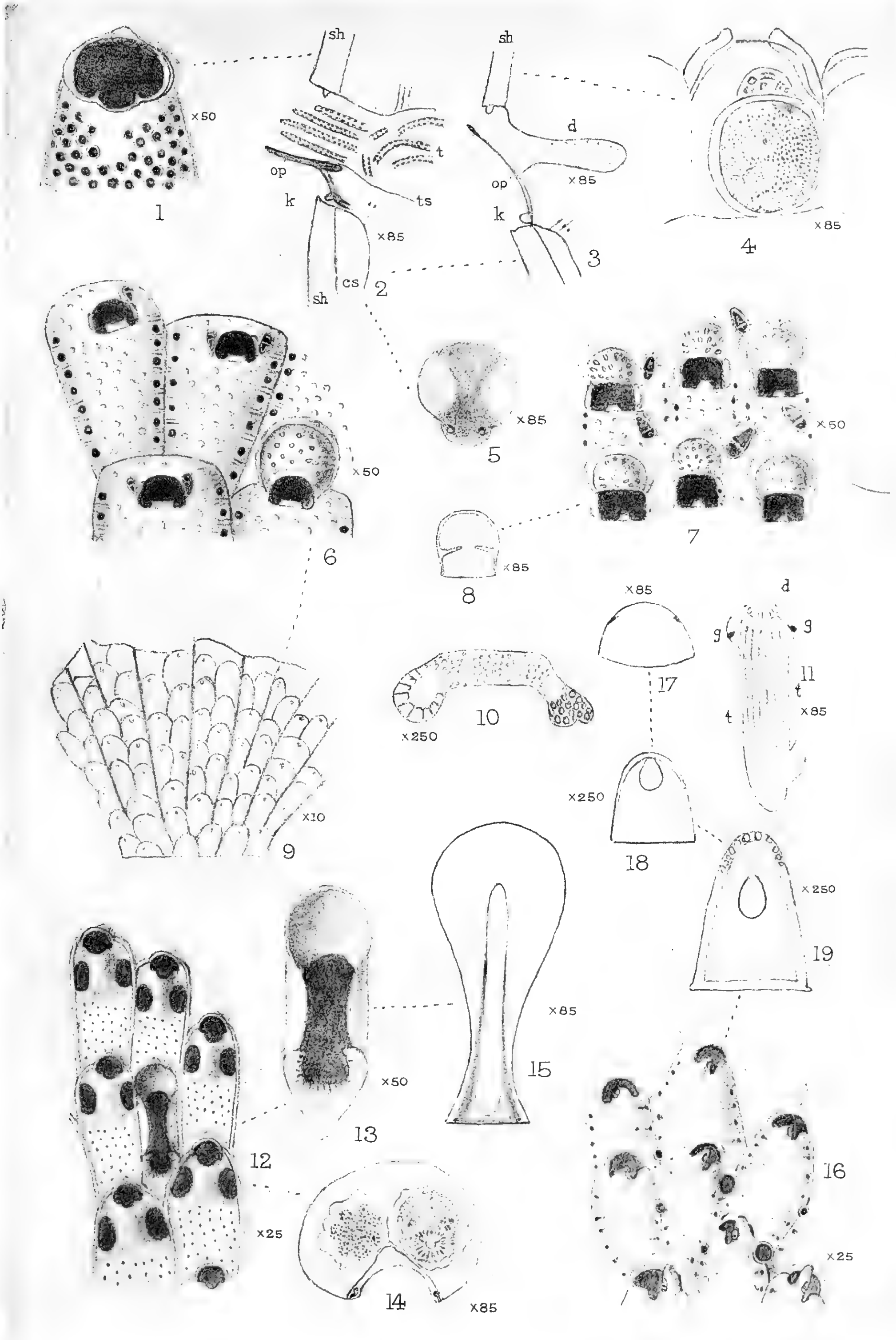

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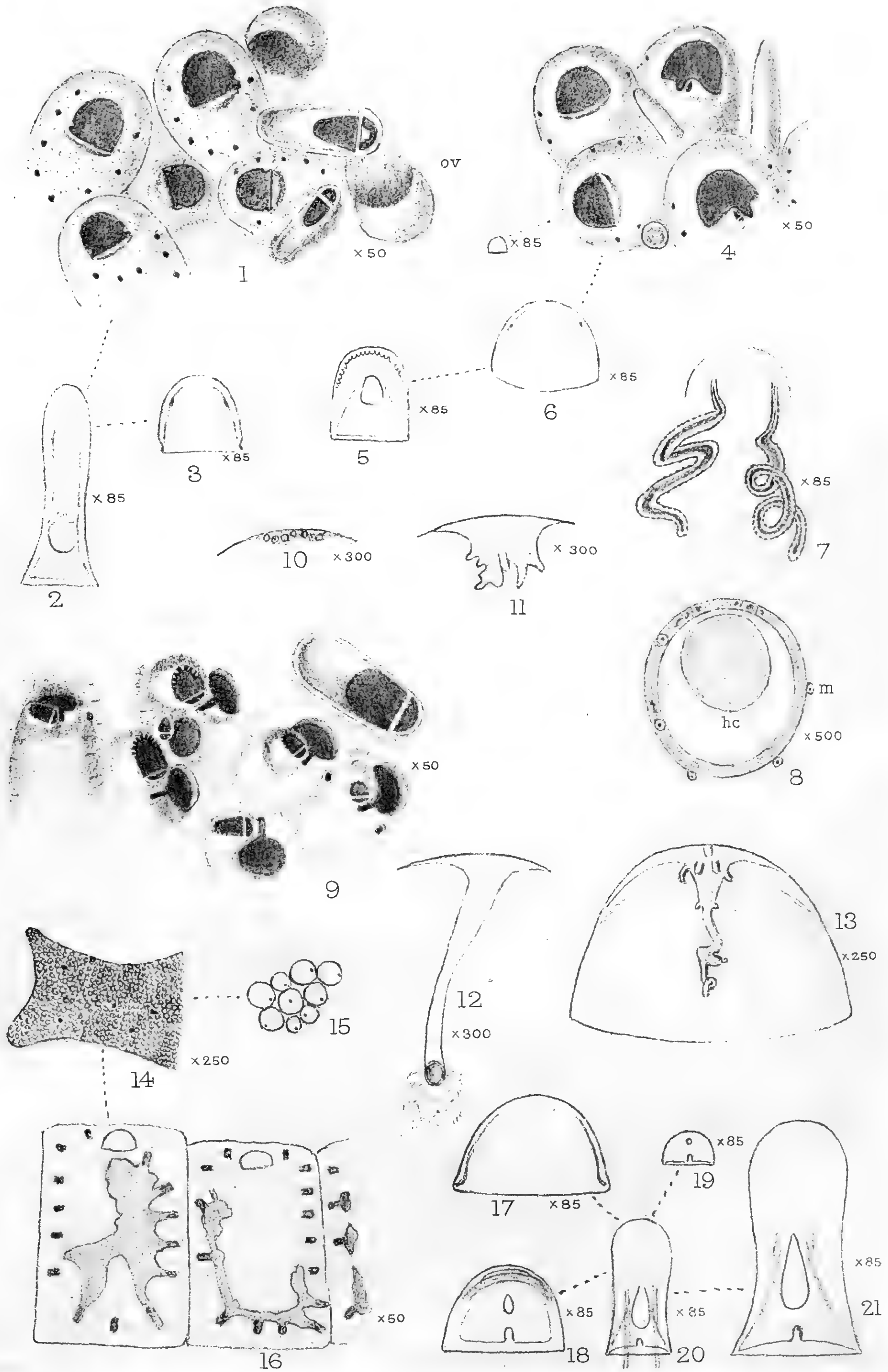

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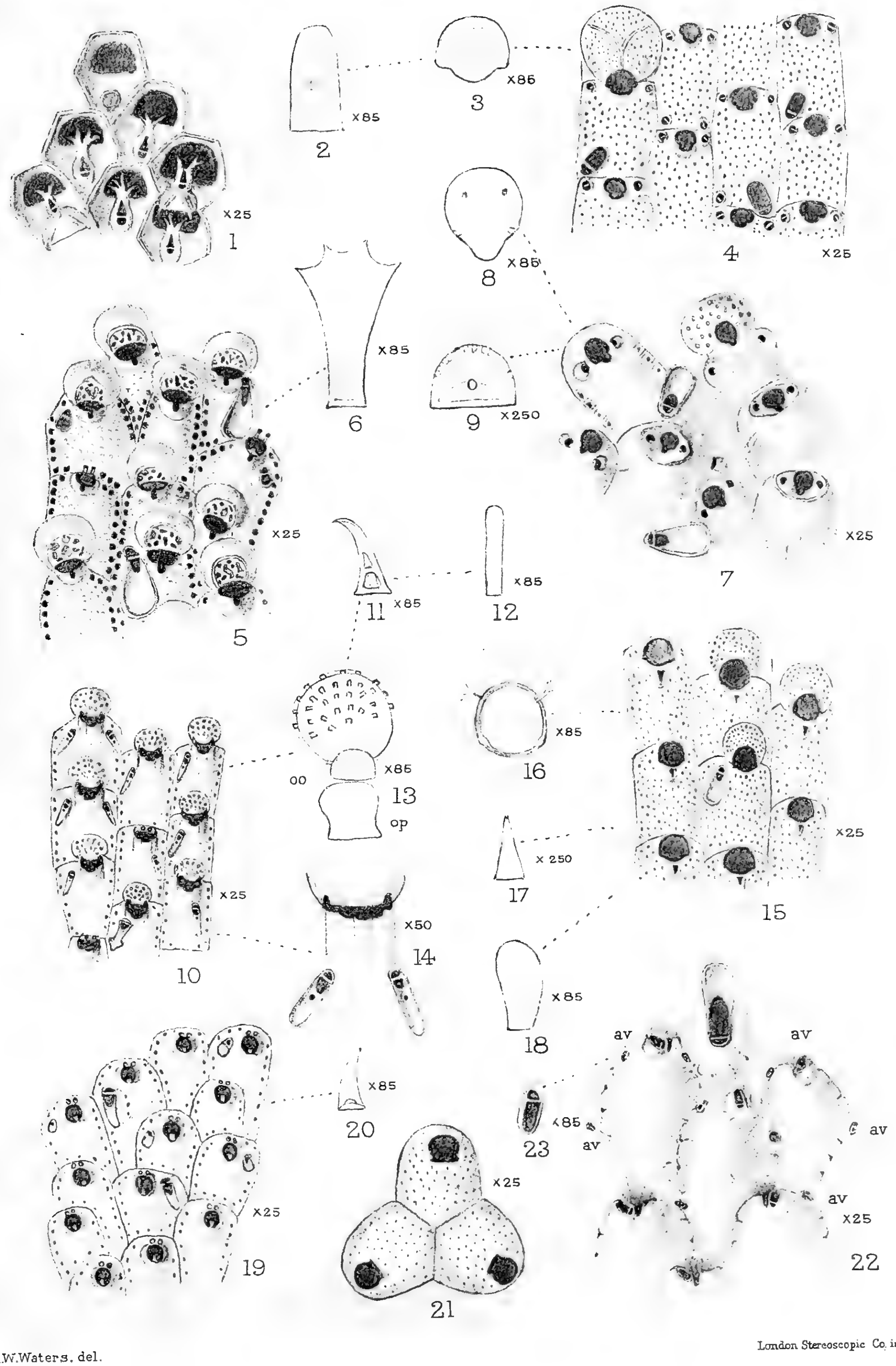

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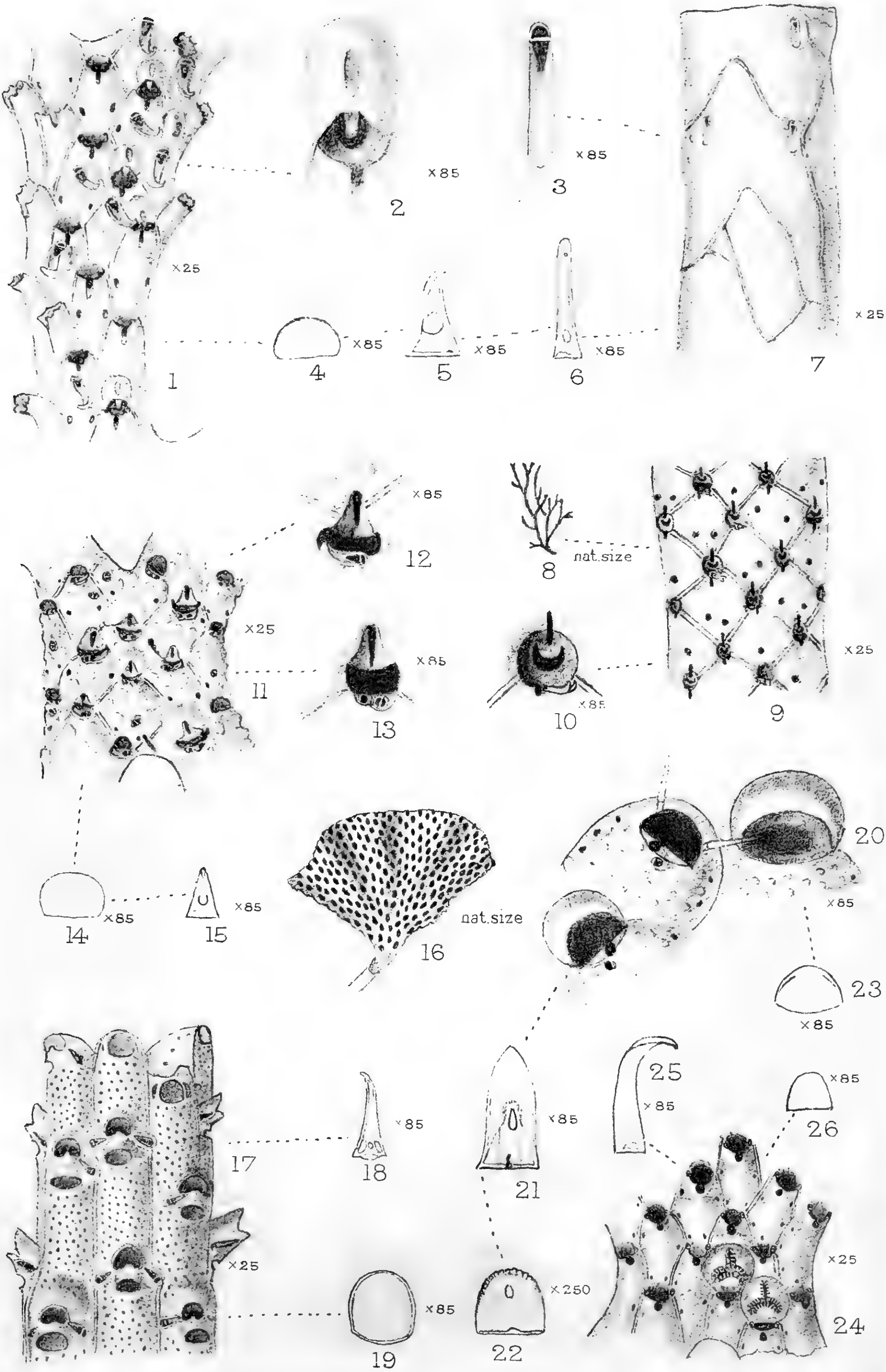

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CHEILOSTOMATA FROM THE RED SEA.

Treasurer's Account for the Year ending April 30th, 1908.

(Presented at the Anniversary Meeting, May 25th, 1908.)

Receipts and Payments of the Linnean Society from May 1st, 1907, to April 30th, 1908.

Receipts.				£	s.	d.
Balance at Bankers on 1st May, 1907				443	8	10
Interest on Investments				232	6	1
Admission Fees				264	0	0
Annual Contributions				1490	0	0
Compositions				194	0	0
Sales of Publications:—						
Transactions	£89	7	4			
Journals	101	6	9			
Proceedings and Catalogues	11	8	0			
				202	2	1
Miscellaneous Receipts				20	16	1
Donations in aid of Publications				200	0	0
Subscriptions to the Darwin-Wallace Celebration				167	14	0
				£3214	7	1

Payments.				£	s.	d.
Taxes and Insurance				10	18	9
Repairs and Furniture				71	11	0
Coals, Electric Current and Gas				52	7	7
Salaries				757	0	0
Library:—						
Books	£214	10	5			
Binding	108	14	10			
				323	5	3
Expenses of Publications:—						
Printing	£709	8	1			
Illustrations	306	13	6			
Distribution	53	3	3			
				1069	4	10
Miscellaneous Printing and Stationery				128	12	11
Petty Expenses (including Tea and Postage)				194	6	4
Investment of Compositions				180	15	0
Balance at Bankers, 30th April, 1908				426	5	5
				£3214	7	1

Investments on April 30th, 1908.

	£	s.	d.		£	s.	d.
Metropolitan $3\frac{1}{2}$ per cent.	1079	11	3	@ 102	1101	3	1
Great Indian Peninsula Railway, Annuity Class B	42	1	5	@ 21	883	9	9
Forth Bridge Railway 4 per cent. Stock	450	0	0	@ 111	499	10	0
Metropolitan 3 per cent.	1000	0	0	@ 93	930	0	0
India 3 per cent.	700	0	0	@ $91\frac{1}{4}$	638	15	0
Metropolitan Water Board 3 per cent. Stock "B" (Westwood Bequest)	232	5	0	@ 91	211	6	11
Eastern Bengal Railway 4 per cent. Debenture Stock	1000	0	0	@ 113	1130	0	0
Great Western Railway 4 per cent. ,, ,,	1000	0	0	@ $117\frac{1}{2}$	1175	0	0
HORACE W. MONCKTON, *Treasurer.*					£6569	4	9

We have (in conjunction with the Professional Auditor, who certifies as to all details) audited the Accounts of the Society for the year ended 30th April, 1908, and found them correct.

HERBERT DRUCE
ALFRED B. RENDLE,
HENRY GROVES,

JAMES P. HILL,
B. DAYDON JACKSON,
Auditors.

W. B. KEEN, *Chartered Accountant.*

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1. No more than Six volumes shall be lent to one person at the same time without the special leave of the Council or one of the Secretaries.

2. All books shall be returned before the expiration of Six weeks from the time of their being taken out, but if not required by any other Fellow, they may, *on application,* be kept for a further period of Six weeks.

3. All books lent shall be regularly entered by the Librarian in a book appropriated for that purpose.

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NOTE.—*Certain other works are included in this prohibition, such as costly illustrated works, and volumes belonging to sets which could not be replaced if lost.*

IN COURSE OF CURRENT ISSUE.

Zoology, Vol. XXX. Nos. 195–198 issued; Nos. 199–202 not yet published.
„ „ XXXI. „ 203–205 issued; remainder not yet published.

NOVEMBER 30. *Price 4s.*

THE JOURNAL

OF

THE LINNEAN SOCIETY.

VOL. XXXI. ZOOLOGY. No. 206.

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1909

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Figs. 11, 12. *Smittia tropica*, sp. nov. Mandibles, × 85.
Fig. 13. Do. do. Decalcified, showing the operculum of the ovicell (*oo*) and the oral operculum (*op*), × 85.
14. Do. do. Peristome and proximal end of the ovicell. The ridges in the peristome are seen distinctly in the semitransparent walls. × 85.
15. *Lepralia Montferrandi*, Sav. & Aud., × 25. From Ras el Millan.
16. Do. do. Operculum, × 85.
Figs. 17, 18. Do. do. Mandibles, × 250 & 85.
Fig. 19. *Smittia nitida*, Verrill, × 25. From Ras el Millan.
20. Do. do. Mandible, × 85.
21. *Lepralia* sp. Primary zooecia, × 25.
22. *Holoporella pigmentaria*, sp. nov., × 25. From Ras el Millan. *av*, avicularia.
23. Do. do. Minute avicularium, × 85.

PLATE 18.

Fig. 1. *Retepora abyssinica*, sp. nov., × 25. From Lat. 16° N., long. 41° W.
2. Do. do. Aperture, × 85.
3. Do. do. Dorsal avicularium, × 85.
4. Do. do. Operculum, × 85.
5. Do. do. Anterior mandible, × 85.
6. Do. do. Dorsal mandible, × 85.
7. Do. do. Dorsal surface, × 25.
8. Do. do. Natural size.
9. Do. do. From older part of a colony, × 25.
10. Do. do. Aperture from older part, × 85.
11. *Retepora jermanensis*, sp. nov., × 25. From Um el Jerman.
Figs. 12, 13. Do. do. Aperture, × 85.
Fig. 14. Do. do. Operculum, × 85.
15. Do. do. Mandible, × 85.
16. Do. do. Natural size.
17. *Gigantopora fenestrata*, Sm., × 25. Three of the zooecia near the distal end are as yet without any arch, but there is an indication of the formation of the avicularian chambers. From Lat. 16° 45′ N., long. 40° 30′ W.
18. Do. do. Mandible, × 85.
19. Do. do. Operculum, × 85.
20. *Holoporella aperta*, Hincks, × 85. From Ras el Millan.
Figs. 21, 22. Do. do. Mandibles, × 85 & 250.
Fig. 23. Do. do. Operculum, × 85.
24. *Retepora hirsuta*, Busk. Piece prepared with Eau de Javelle, × 25. From Lat. 16° N., long. 41° W.
25. Do. do. Mandible, × 85.
26. Do. do. Operculum, × 85.

Reports on the Marine Biology of the Sudanese Red Sea.—XIII. Report on the Sponges, collected by Mr. Cyril Crossland in 1904–5.—Part I. Calcarea. By R. W. Harold Row, B.Sc., F.L.S., Assistant Demonstrator in Zoology at King's College, University of London.

(Plates 19 & 20.)

[Read 17th June, 1909.]

The Calcarea collected in the Red Sea by Mr. Crossland consist of 16 species, of which six are new to science. They are distributed among five old and two new genera.

The classification adopted in this report is that of Minchin (12) for the Homocœla and that of Dendy (2) for the Heterocœla, the latter, however, modified by the retention of the family Pharetronidæ and by the addition of a new family, Grantillidæ, for two species of a new genus, *Grantilla*.

A list of the species is as follows :—

Clathrina coriacea (Montagu).
Clathrina primordialis (Haeckel).
Clathrina canariensis, var. *compacta* (Schuffner).
Clathrina tenuipilosa (Dendy).
Sycon coronatum (Ellis & Solander).
Sycon raphanus, O. Schmidt.
Leucandra primigenia (Haeckel).
Leucandra primigenia var. *microraphis* (Haeckel).
Leucandra aspera (O. Schmidt).
Grantilla hastifera, n. g. & sp.
Grantilla quadriradiata, n. sp.
Grantessa glabra, n. sp.
Leucilla bathybia (Haeckel).
Leucilla intermedia, n. sp.
Leucilla crosslandi, n. sp.
Kebira uteoides, n. g. & sp.

To these species must be added, in order to complete the Red Sea Calcarea, the following three species not represented in this collection :—

Clathrina darwinii (Haeckel) (8).
Grantessa (*Sycetta*) *stauridia* (Haeckel) (8).
Leucandra (*Leucortis*) *pulvinar* (Haeckel) (8).

The collection is extremely interesting owing to its strikingly intermediate character between the faunas of the Mediterranean and Atlantic on the one hand, and of the Indian Ocean on the other, as is shown by the subjoined table, in which it should be noted that the coasts mentioned always include the islands near them.

	Atlantic Coasts of America.	Atlantic Coasts of Africa.	Atlantic Coasts of Europe.	Mediterranean.	Red Sea.	East Coast of Africa.	East Indies & Ceylon.	Pacific Coasts of Asia.	Pacific Coasts of America.	Australasia.
Clathrina coriacea	..	..	×	..	×	..	..	..	..	..
,, *primordialis*	×	×	..	×	×	×	×	×	..	×
,, *canariensis* var. *compacta*	..	×	..	..	×	×	..	..	..	..
,, *tenuipilosa*	..	×	..	..	×	..	×	..	..	..
,, *darwinii*	..	..	..	..	×	×	×	..	..	..
Sycon coronatum	..	..	×	×	×	..	..	..	×	×
,, *raphanus*	..	..	..	×	×	..	×	×	..	×
Leucandra primigenia	×	×	..	×	×	×	×	..	×	×
,, *microraphis*	..	..	..	..	×	..	?	..	..	×
,, *aspera*	..	..	..	×	×	..	..	..	..	..
,, *pulvinar*	..	..	..	..	×	..	×	..	..	×
Grantilla hastifera	..	..	..	..	×	..	..	..	..	..
,, *quadriradiata*	..	..	..	..	×	..	..	..	..	..
Grantessa glabra	..	..	..	..	×	..	..	..	..	..
,, *stauridia*	..	..	..	..	×	..	..	..	..	..
Leucilla bathybia	..	..	..	..	×	×	..	..	..	×
,, *intermedia*	..	..	..	..	×	..	..	..	..	..
,, *crosslandi*	..	..	..	..	×	..	..	..	..	..
Kebira uteoides	..	..	..	..	×	..	..	..	..	..

The preservation of the specimens is unfortunately not sufficiently good to render them available for histological study.

Numbers in parentheses refer to the literature quoted at the end of the paper.

I take this opportunity of expressing my gratitude to Professor Dendy, by whose kindness I obtained the collection for examination, and whose suggestions and advice have been invaluable to me throughout the work, which has been carried out in the Zoological Laboratory at King's College (University of London).

Grade HOMOCŒLA, *Poléjaeff.*

Family CLATHRINIDÆ, *Minchin.*

CLATHRINA CORIACEA (*Montagu*).

Synonymy :—
1818. *Spongia coriacea*, Montagu (**13**).
1842. *Grantia coriacea*, Johnston (**10**).
1864. *Leucosolenia coriacea*, Bowerbank (**1**).
1867. *Leucosolenia coriacea*, Gray (**6**).
1872. *Ascetta coriacea*, Haeckel (**8**).
1905. *Leucosolenia coriacea*, Dendy (**3**).

There were two specimens in the collection, one from Agig Harbour in $4\frac{1}{2}$ fathoms, one from off an Antipatharian growing on mud in 10 fathoms at Khor Ahullarnama.

Distribution. Atlantic coasts of Europe ; Great Britain ; Red Sea.

CLATHRINA PRIMORDIALIS (*Haeckel*).

Synonymy :—
1871. *Ascetta primordialis*, Haeckel (**8**).

One specimen only, from loose coral at the edge of the leeward reef of Tella Tella Kebira.

Distribution. Cosmopolitan.

CLATHRINA CANARIENSIS (*Miklucho*), var. COMPACTA (*Schuffner*).

Synonymy :—
1868. *Nardoa canariensis*, Miklucho (**11**).
1872. *Ascaltis canariensis*, Haeckel (**8**).
1877. *Ascaltis compacta*, Schüffner (**16**).
1908. *Leucosolenia canariensis*, Thacker (**18**).

The specimen is identical with the *C. compacta* described by Schuffner (**16**) from Mauritius, but this species cannot apparently be separated from *C. canariensis*, as all intermediate forms have been described by Thacker (**18**) from the Cape Verde Islands.

Since, however, the variety here dealt with differs so much from the typical *C. canariensis* as described by Haeckel, it seems wise to designate it as a distinct variety. The single specimen in the collection was obtained from the shore at Suez.

Distribution. Mauritius, Red Sea, Cape Verde.

CLATHRINA TENUIPILOSA (*Dendy*).

Synonymy :—
1905. *Leucosolenia tenuipilosa,* Dendy (**3**).
1908. *Leucosolenia canariensis,* Thacker (**18**).

This species is by far the most abundant of the Homocœla in the collection, having been obtained at Suez growing on mud; from Beacon Island, Khor Dongola, on millepore-reef; from Agig Harbour, from mud in $4\frac{1}{2}$ fathoms; and from the coral-reef at Engineer Island, Khor Dongola.

Like the preceding species, it was considered by Thacker (**18**) to be only a variety of *Clathrina canariensis* on the strength of the similarity of the tri- and quadriradiates; but it seems to me that the presence of oxea of such unusual and constant form, being very long and extremely slender, should undoubtedly separate it specifically from forms where oxea are entirely absent, even though the number and frequency of the oxea may show very considerable variation as they do in Thacker's specimens.

Distribution. Ceylon, Red Sea, Cape Verde.

Grade HETEROCŒLA, *Poléjaeff.*

Family SYCETTIDÆ, *Dendy.*

SYCON CORONATUM (*Ellis & Solander*).

Synonymy :—
1786. *Spongia coronata,* Ellis & Solander (**4**).
1821. *Scypha coronata,* Gray (**7**).
1864. *Grantia ciliata,* Bowerbank (**1**).
1867. *Spongia coronata,* Grant (**5**)
1872. *Sycandra coronata,* Haeckel (**8**).
Sycon ciliatum, } mult. auct.
Grantia ciliatum, }

A single very small specimen measuring only 8 mm. to the top of the oscular fringe, of which length this fringe comprises 4 mm., and with a horizontal oscular collar 4 mm. in diameter, was obtained, from a locality not stated.

Distribution. Cosmopolitan.

SYCON RAPHANUS, *O. Schmidt.*

Synonymy :—
1862. *Sycon raphanus,* O. Schmidt (**15**).
1867. *Grantia raphanus,* Gray (**6**).
1872. *Sycandra raphanus,* Haeckel (**8**).

A single small specimen was obtained from the dock-wall at Suez.

Distribution. Cosmopolitan.

Family GRANTIDÆ, *Dendy*.

LEUCANDRA PRIMIGENIA (*Haeckel*).

Synonymy :—
1872. *Leucetta primigenia,* Haeckel (8).
1905. *Leucandra primigenia,* Dendy (3).

A single specimen from the mud flats at Suez.
Distribution. Cosmopolitan.

LEUCANDRA PRIMIGENIA var. MICRORAPHIS (*Haeckel*).

Synonymy :—
1872. *Leucetta primigenia* v. *microraphis,* Haeckel (8).

Two specimens, one from the coral-reef on Engineer Island, Khor Dongola, the other from a piece of coral near the reef off Cape Elba, Egyptian Sudan frontier, in 10 fathoms of water.
Distribution. Red Sea ; Torres Straits, Australia.

LEUCANDRA ASPERA (*O. Schmidt*).

Synonymy :—
1852. *Sycon asperum,* O. Schmidt (15).
1866. *Grantia aspera,* O. Schmidt (15).
1867. *Grantia aspera,* Gray (6)
1872. *Leucandra aspera,* Haeckel (8).

A considerable number of fragments, none more than 10 mm. in diameter, occur in the collection from the mud flats and a buoy in Suez Harbour.
Distribution. Mediterranean; Red Sea.

Family GRANTILLIDÆ, nov.

A dermal cortex is always present covering over the chamber layer. The skeleton includes subdermal prochiacts *, and may or may not include subdermal sagittal triradiates and subdermal quadriradiates. Subgastral prochiacts may or may not be present. Chambers and skeleton arrangement as in the Grantidæ.

As only a single genus is at present included in the family it is unnecessary to discuss the family characters separately.

* For definition of this term see description of the genus *Grantilla*.

Genus GRANTILLA, n. g.

Grantillidæ with syconoid canal-system, consisting of radially disposed flagellated chambers, supported by an inarticulate tubar skeleton.

The two specimens in the collection, each representing a distinct species, for which this new genus and family have been founded, possess certain distinctive features in their spiculation not hitherto described for any calcareous sponge. The most noteworthy of these is the occurrence of three distinct kinds of subdermal spicules, namely, quadriradiate, sagittal triradiate, and a modified form of triradiate, which from its similarity to the quadriradiates described by Jenkin (9) as chiactines, I have called a "prochiact."

It seems advisable, both for the complete appreciation of the meaning of this spicule, and also in order to avoid confusion as to the nomenclature employed to describe it, first of all to define the terms used in referring to triradiates generally, and then to state the views set forth in this paper on the evolution of this spicule.

The most typical triradiate spicule is one in which all the rays and angles are equal and which lies tangentially in the body-wall of the sponge, all the rays being in the same plane. As a general rule, however, some of the rays are somewhat modified so that it is possible to distinguish two of the rays from the third either by form, or by the inequality of the angles separating them, or by both at once. To describe these "sagittal" spicules the following terms are used. The two rays still equal are called the *paired* or *oral* rays, and the remaining ray is called the *basal* or aboral ray. The angle between the oral rays is called the *oral angle*, whether larger or smaller than the others, which are called the *paired* angles. The primitive plane in which all three rays lie may be called the *facial plane*.

In the primitive Olynthus, the basal ray lies pointing away from the osculum and the paired rays toward it. In the radial chambers of the syconoid canal-system the paired rays point toward the gastral cavity, and the basal away from it. When the chamber is strongly curved the paired rays tend to encircle it.

In describing a *quadriradiate* the three rays in one plane, regarded as the equivalents of the rays of a triradiate, are called the *facial* rays, and the fourth, or extra, ray the *apical*, or gastral ray. Moreover, all the modifications described above as possible in a triradiate are equally possible to the facial rays of a quadriradiate, and the same terms are equally applied to them.

It is considered that the *prochiact* (fig. 1, *b*) has been derived from a tangentially lying cortical triradiate (fig. 1, *a*), by a change in position of the basal ray, which, instead of lying tangentially in the cortex, has been turned

until it lies radially, along the side of a flagellated chamber, and at right angles to the facial plane. The oral rays, on the other hand, still lie in the cortex, and, at any rate so far as their distal portions are concerned, in the primitive facial plane. The proximal part of the oral rays is frequently gradually curved between the tangential and radial positions. The oral angle of the prochiact is of course the angle in the primitive facial plane between the paired rays.

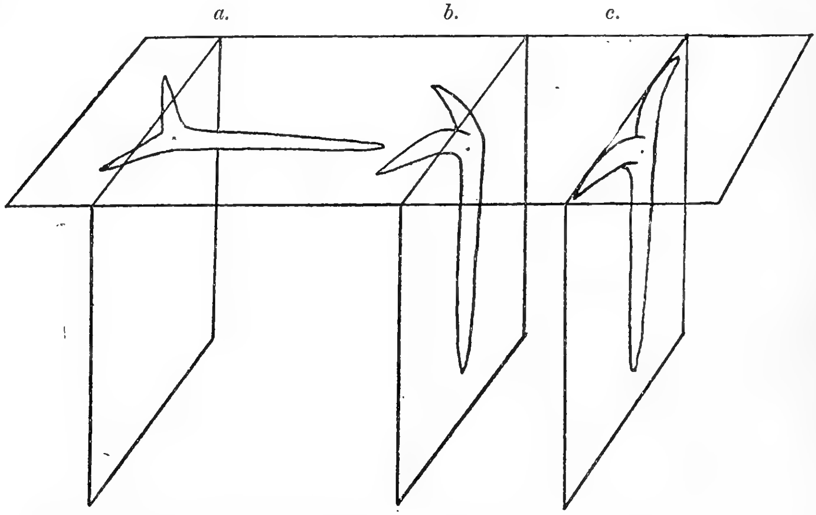


Fig. 1.—Diagram of the evolution of secondary sagittal triradiate (*c*) through a prochiact (*b*) from an ordinary sagittal triradiate (*a*).

A further development of this spicule, however, to form what we may term a *secondary* * sagittal triradiate, takes place by the gradual widening of the primitive oral angle until it becomes 180°, *i. e.* until the paired rays come to lie exactly opposite each other, and once more in one plane with the basal ray (fig. 1, *c*). In this way a new or *secondary* oral angle is developed, quite distinct from the primitive oral angle of the primitive facial plane, since it is bounded by different regions of the rays, the regions bounding the primitive oral angle now forming the sides of the rays. There is also established a secondary facial plane at right angles to the original one, by this alignment of the paired rays. The spicule thus formed is in shape a typical sagittal triradiate, and I believe that such spicules form the characteristic subdermal sagittal triradiates of the family Heteropidæ. In practice it must often be impossible to distinguish between secondary and primary sagittals.

A discussion of this view as to the nature and origin of the prochiacts, and also the evidence which has led to its adoption, will be given later on, when dealing with the evolution of the family Heteropidæ.

* The term *secondary* is here used only in a general sense, and it must be understood that the secondary sagittal spicules referred to in this paper are not of necessity equivalent to secondary sagittal spicules described by other authors.

Jenkin's chiactines, save that they possess an apical ray, are very similar to prochiacts. The basal ray lies in the wall of the chamber, "viewed along the axis of the basal ray, the paired rays are seen to be folded to one side" (Jenkin). The apical ray of a quadradiate is, so far as we know from other cases, both developmentally and phylogenetically a structure of much later origin than the facial rays. Jenkin, moreover, states that in *Streptoconus*, whose canal-system is the most primitive of all the chiact-bearing sponges at present described, some of the chiactines lack the apical ray. (They are therefore prochiacts.)

The extreme similarity between the chiactine and the prochiact above described is thus evident, the only difference, save as regards the apical ray, being that the oral angle of the chiactine, to judge by Jenkin's figures, is greater than that of the prochiact. The presence of a complete series in *Grantilla*, however, in which spicules are found whose original oral angle may be widened out to anything between 90° (in some prochiacts) and 180° (in the secondary sagittal triradiate), is evidence that this difference is of very slight significance; and if, as I shall hope to demonstrate hereinafter, the prochiact is primitive, and the others, in which the primitive oral angle is larger, are more modified, then the width of the primitive oral angle of the chiactine would be clearly accounted for as a similar development of the primitive type towards a uniplanar spicule. The chiactine may therefore be looked upon as a direct development of the prochiact by the addition of an apical ray.

Both the species of *Grantilla* possess prochiacts both in the subdermal and subgastral layers, and these spicules form a very large proportion of the tubar skeleton in each case. There are present, however, subgastral and subdermal sagittal triradiates, and, as above stated, intermediate forms are common. Further, in one of the species here described, *Grantilla quadriradiata*, there also occur subdermal quadriradiates, with the apical ray pointing gastralwards.

Thus these sponges unite in themselves the characteristic features of the spiculation of three groups, the Amphoriscidæ, the Heteropidæ, and the two chiactine-bearing families, the Chiphoridæ and the Staurorrhaphidæ.

The most primitive sponge in which chiactine (and prochiact) spicules occur is *Streptoconus*, which, save for the presence of these spicules, would be placed in the genus *Sycetta*, the canal-systems of the two sponges being absolutely similar. The occurrence in so primitive a type of sponge of this spicule indicates its very great phyletic antiquity, showing in fact that the prochiact must have originated previous to the development of a dermal cortex. It is at this point that I differentiate the Grantillid line of descent from that of the Sycettidæ–Grantidæ, including in the former line all those families which either still possess, or presumably have had in the history of their evolution, prochiact spicules. (See phylogenetic tree on p. 192.)

Of these, the two families of chiactine-bearing sponges, the Chiphoridæ and

the Staurorrhaphidæ, form an extremely compact and definite group, exactly comparable to that formed by the two families Sycettidæ and Grantidæ. The Staurorrhaphidæ are immediately derivable from the Chiphoridæ by the development of a dermal cortex.

These two families would thus form a branch diverging from the main Grantillid stem almost immediately after the appearance of the primitive prochiact, the point of divergence being marked by the development of the apical ray, transforming the prochiact into the chiactine.

It is possible to derive the genus *Grantilla* in two entirely different ways. According to one view there is no connection whatever between the Chiphoridæ and Staurorrhaphidæ on the one hand and this genus on the other. *Grantilla* would then be a direct development from the typical Heteropid form, by the bending of the paired rays of some of the sagittal triradiates. Against this view there are however several, to my mind, very serious objections. It implies that two spicules of peculiar and extremely similar shape and occupying similar positions in the sponge-wall, namely, the subgastral prochiact and the chiactine, should have been developed independently at two different times in the phyletic history of the Heterocœla. It necessitates, further, our belief that these two spicules should have developed by entirely different methods from spicules of entirely different type; for Jenkin (**9**) is of the opinion that the chiactines are developed from the gastral quadriradiates. Another objection to this view is the presence of subdermal quadriradiates in *Grantilla quadriradiata*; so that if the Grantillidæ are to be derived from the Heteropidæ, it must be assumed that the spiculation of all these sponges is extremely liable to variation. This interpretation of these sponges would be in direct opposition to the principles of classification suggested by Dendy (**2**), who lays very great stress upon the stability of the composition and arrangement of the skeletal elements in the different families of the Heterocœla. It is, however, possible, as Professor Dendy has suggested to me, to give to the Grantillidæ an interpretation in which none of these difficulties appear, namely, that they are a primitive group, derived from the same ancestors as the Chiphoridæ and the Staurorrhaphidæ, and representatives of the original line of descent from which the Heteropidæ and the Amphoriscidæ have been derived by specialization of their respective characters.

The Grantillidæ would thus be immediately derived from the primitive prochiact-bearing stock by the appearance of a dermal cortex. That a dermal cortex has originated more than once in the history of the Heterocœla is made evident by a consideration of the two families Grantidæ and Staurorrhaphidæ. To derive the Staurorrhaphidæ from the Grantidæ would necessitate the diphyletic origin of chiactines; to derive them from the Chiphoridæ necessitates a similar diphyletic origin for the dermal cortex. Of these two alternatives the latter is by far the most simple; the direct continuity of the line Chiphoridæ–Staurorrhaphidæ, the peculiarly restricted distribution of

these two families, and the obvious identity of their chiactines, all indicating that the Staurorrhaphidæ are directly derived from the Chiphoridæ.

It must thus, in any case, be assumed that a dermal cortex has appeared independently in two different groups; and the occurrence of a third independent appearance of this structure, as shown above, for the Grantillidæ, presents no serious difficulty. This, doubtless, took place very early indeed in the history of the Grantillidæ, very soon after the first appearance of the subgastral prochiact, and while the skeletogenous cells were still plastic and easily influenced by varying conditions. Previously to the appearance of the dermal cortex, the only support for the chamber-layer consisted in a system of small spicules in the walls of the chamber, completely separate from the skeleton of the adjacent chambers, to which its only skeletal union was through the mediation of the gastral cortex. Immediately upon the appearance of a dermal cortex, however, many new opportunities arise for strengthening the skeletal framework.

In many cases this strengthening consists in the development of the cortex to enormous proportions, with a special skeleton consisting of either large oxea or triradiates tangentially arranged, as in *Ute* in the Grantidæ and *Grantiopsis* in the Staurorrhaphidæ. Among the Grantillidæ the same result has been obtained in an entirely different way, namely, by the development of subdermal spicules with one ray pointing gastralwards. Two entirely different types of spicule have thus appeared simultaneously, the prochiact and the quadriradiate. The presence of a complete series of stages between the prochiact and the secondary sagittal triradiate seems to me to be conclusive proof that these two forms are not separate developments, but that one of them is directly derived from the other.

An imaginary primitive or Prograntillid type might be diagnosed as follows:—"Calcarea with a distinct dermal cortex covering the chamber-layer. Canal-system syconoid, with an articulate tubar skeleton supplemented by subgastral prochiacts and subdermal prochiacts, sagittal triradiates and quadriradiates." This may be considered to have been the ancestral type from which the living Grantillidæ, the Heteropidæ, and the Amphoriscidæ have all been derived. The Grantillidæ, at any rate in so far as they are represented by the genus here under consideration, *Grantilla*, have reached their present form by the retention of all the types of subdermal spicule, and the loss of the primitive articulate tubar skeleton. The Heteropidæ, on the other hand, have specialized in the subdermal sagittal triradiates, and no longer possess either subdermal prochiacts or quadriradiates; while the Amphoriscidæ have lost the whole of the prochiact–sagittal triradiate series, and have retained the subdermal quadriradiates only.

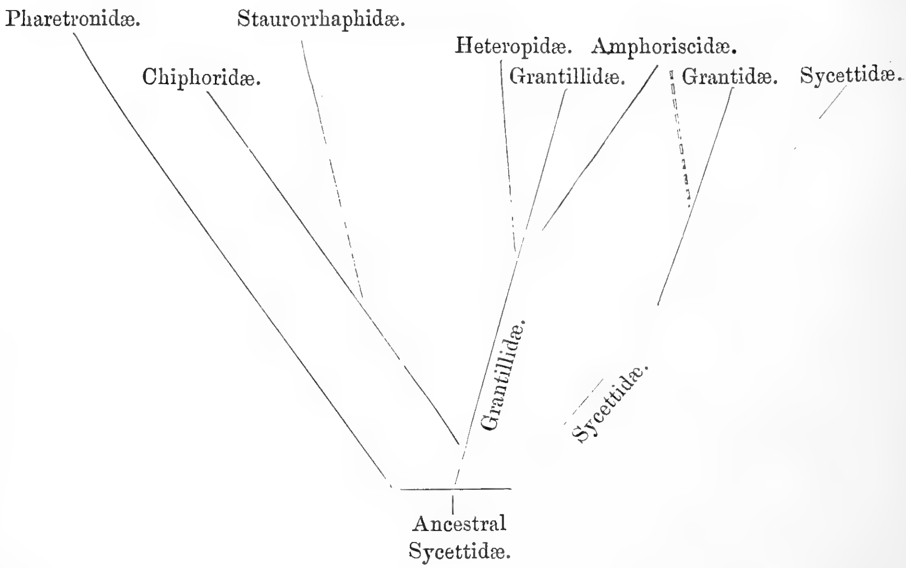
Since arriving, in conjunction with Professor Dendy, at the above conclusions with regard to the phylogeny of the Heterocœla, I have seen a paper by Geoffrey Smith, on the Anaspidacea (**17**), in which he develops the same

view of evolution by specialization on one of many characters all found in the primitive type. His remarks have such a close connection with the above interpretation, that I think it well to quote them somewhat fully. He says:—"... . the primitive ancestors of the specialized groups are not distinguished from their modern representatives so much by simplicity of structure, but rather by combining in themselves the heterogeneous elements which have been segregated out in the course of evolution and separated into the different streams of descent that have given rise to the modern groups."

It was the habit of morphologists, and perhaps still is, "to imagine that a primitive ancestral form must have been simpler and have exhibited less complication of structure than its modern representatives. . . . ."

The conclusions of this author form a very striking confirmation of the views of the evolution of the Heterocœla brought forward in this paper, and form an exceedingly strong argument on behalf of the position assigned to the Grantillidæ herein.

The above view of the evolution of the Heterocœla is shown below by means of a phylogenetic table :—



The Amphoriscidæ are characterized by the presence of conspicuous subdermal quadriradiates, with their apical rays directed gastralwards. These quadriradiates have undoubtedly been produced by the addition of an apical ray to ordinary (regular or sagittal) tangentially placed dermal triradiates.

It seems to me extremely doubtful whether the family is monophyletic in origin, and although I have not broken it up in the present instance, I am of the opinion that it will be found necessary to do so in the near future.

The series *Leucandra–Leucilla* is an eminently natural one, species like *Leucandra verdensis,* Thacker (**18**) and *Leucilla intermedia*, n. sp., described below, being directly intermediate between the typical Leucandras, which have no subdermal quadriradiates,and the typical Leucillas, in which they are extremely large. *L. verdensis*, although possessing subdermal quadriradiates, is placed in the genus *Leucandra* by Thacker on account of the "inconspicuousness" of these spicules (*cf.* diagnosis of the family Amphoriscidæ in Dendy (**2**)), in comparison with the dermal tangentially lying triradiates; while my new species *L. intermedia,* in which the quadriradiates are but little larger, has been placed in the genus *Leucilla* since the dermal triradiates are by no means so large as the quadriradiates, which are therefore "conspicuous." In both these species the apical rays are small in comparison with the facial rays. On the other hand, it is obviously impossible to derive such genera as *Syculmis* and *Amphoriscus,* in which the canal-system is syconoid or sylleibid, from any form which has, like *Leucandra*, a typically leuconoid canal-system. It is therefore suggested that the "Amphoriscidæ Sycones" are derived from the Grantillidæ, and the "Amphoriscidæ Leucones" from the leuconoid Grantidæ.

The Heteropidæ, which like the Amphoriscidæ are descended from primitive Grantillid ancestors, possess features far more difficult of explanation than do the Amphoriscidæ. Chief amongst these is the occurrence of subdermal sagittal triradiates and prochiacts.

It is impossible to derive these spicules from any tangential dermal spicules merely by the addition of a ray, as in the case of the quadriradiates, and they must therefore have been developed either as a completely new structure, or by a change of position of one or more of the rays of an existing spicule.

On behalf of the second of these two views, that these spicules are developed from dermal triradiates by a bending of the basal ray, there is strong presumptive evidence to be obtained from the study of the development of the chiactines of the Chiphoridæ and the Staurorrhaphidæ.

In six species out of nine Jenkin states that the chiactines, which do not extend right up to the osculum, are replaced in that region by ordinary gastral quadriradiates, whose facial rays lie in the primitive facial plane and whose apical rays point into the gastral cavity. Between the areas in which these two types occur, there is an intermediate region in which quadriradiates are found "in all intermediate positions between tangential and centrifugal," *i. e.*, with the basal ray directed in all intermediate positions between aborally, as in the gastral quadriradiate, and dermalwards, as in the typical chiact. This change of position, he suggests, is caused by the appearance of the flagellated chambers, which continually appear in that region as the sponge elongates, so that "the spicules formed in the oscular collar may be supposed to be turned round by the development of flagellated chambers under their basal rays. A very similar tipping of dermal triradiates, due to the growth under them of

the flagellated chambers, occurs at the base of the collar in *Tenthrenodes antarcticus*." (Jenkin, **9**.)

We thus have a description of the formation of chiacts direct from gastral quadriradiates by a direct change of position. The result of the "tipping" in *Tenthrenodes* is less clear, as there never occur any *sub*dermal spicules in this genus, *i. e.* spicules with a ray pointing gastralwards.

As regards the two species of *Grantilla*, I have been unable to make any investigations on *G. quadriradiata*, as the single specimen obtained by Mr. Crossland consists of a fragment from which the oscular portion has been lost. In *G. hastifera* I found that neither subgastral nor subdermal triradiates or prochiacts extend quite to the oscular rim, but that there is, as in the Chiphorid and Staurorrhaphid species, a small area in which they are not arranged absolutely radially, but are slightly inclined on both surfaces. This inclination does not seem to be always in the same direction, but may be either oral- or aboralwards. The spicules in this region of the sponge are considerably smaller than the full-grown ones, being not much larger than the triradiates of the dermal and gastral cortices. Above the region of irregularly placed prochiacts and triradiates it was found impossible to distinguish them from the cortical spicules. Owing to the preservation of the specimens not being sufficiently good, I found it impossible to obtain any histological details of their development.

It is therefore impossible to be absolutely certain that these subdermal and subgastral spicules are derived directly from the dermal and gastral cortical triradiates by a change of position, though the facts given above and the great similarity of the spicules in the different genera are very strongly in favour of such a derivation; and it seems undoubtedly easier to so derive them, especially as it is possible to do so in entire harmony with the known facts, rather than to consider them an entirely new structure with an origin entirely independent of any existing spicule.

The retention of the paired rays of the prochiact in the primitive facial plane can also be explained very easily in accordance with this view. The change of position of the spicule must undoubtedly commence while it is quite small, and must be a gradual process, as it presumably depends upon the growth of the flagellated chambers under it for its accomplishment, at any rate in the case of the subgastral spicules.

Since the gastral and dermal cortices are separated by the growth of the flagellated chambers, there will be no obstruction in the way of the basal ray as it gradually assumes the radial position ; but to the movement of the paired rays, which it must be remembered are growing during the whole of this period, a very serious obstruction is opposed by the presence of a cortex.

Were the additional calcite secreted by the calcoblasts deposited along the line of the axis of the ray, the ray as it elongated would have to force its way through the cortex as the spicule turned, whereas this difficulty would be

entirely obviated if the further growth of the paired rays continued along the original lines occupied by the spicule, *i. e.* in the primitive facial plane, each portion of calcite secreted being thus a little more out of line with the basal ray than the last. This would fully explain the peculiar curvature of the paired rays of the prochiact, and since the dermal and gastral cortical triradiates in *Grantilla* are very nearly regular, the oral angle between the rays of the original cortical triradiate is very similar to the oral angle of a prochiact.

It is, however, more difficult to understand how the growth of the flagellated chambers can cause the change of position in the case of the subdermal triradiates and prochiacts, though the evidence in favour of a similar origin to that of the subgastral spicules is very strong. Like the similar subgastral spicules, they lie in the region of the oscular rim in *Grantilla hastifera* in intermediate positions between tangential and radial, while, as quoted above, Jenkin (**9**) states that in *Tenthrenodes* such a "tipping" is actually caused by the growth of the chambers.

These arguments imply that the prochiact is more primitive than the subdermal sagittal triradiate, which will then be derived from it by the widening of the oral angle by the turning of the paired rays until they lie in one plane with the axis of the basal ray (fig. 1, p. 188); and the immediate derivation of one from the other is rendered certain by the absolutely complete series of intermediate forms which occur in *Grantilla.* This series is as complete on the subgastral surface as on the subdermal, and leads to the conclusion that the subgastral sagittal triradiates of *Grantilla* are derived, like the subdermal, *viâ* prochiacts from the cortical triradiates. It is, of course, not suggested that spicules once formed change from prochiacts to sagittal triradiates, but that this change has occurred during the evolution of the group.

It also leads to the conclusion that the subgastral sagittal triradiate of such a form as *Grantilla*, and probably also of the Heteropidæ, is entirely different from the sagittal triradiate of the first joint of the ordinary articulate tubar skeleton, being secondary in origin, and therefore that the inarticulate tubar skeleton is an entirely new structure, supplanting and replacing the articulate, instead of being derived from it.

In dealing with the question of these secondarily formed sagittal triradiates, the researches of von Ebner (**19**) into the physical characters of spicules are of very great importance.

Von Ebner (**19**) studied this question in a large number (14) of species, including members both of the Homocœla and the Heterocœla, and deduced, from the behaviour of their spicules when examined under polarized light, the occurrence of "secondary" sagittal triradiates differing markedly in their optical orientation from the primitive sagittal triradiates.

In examining a typical regular triradiate by polarized light, it is found that

the whole spicule behaves as a single crystal, with its optic axis lying perpendicularly to its facial plane. Similarly, the optic axis of a quadriradiate lies perpendicular to its facial plane, and therefore corresponds with the morphological axis of its apical ray. It should, however, be noted, as von Ebner points out, that, owing to the curvature of the surface of the sponge and of the chambers in those species possessing a syconoid canal-system, the facial rays of a spicule rarely lie in one plane, but are usually in the form of an extremely low and widespread tripod. References to the facial plane must therefore be taken to refer to the plane containing the apices of the three rays, whether or not this should also contain the other portions of the rays. There must therefore also be distinguished the true oral angle from the angle seen between the paired rays when the spicule is viewed as though projected in the facial plane, as is the case in ordinary microscopic examination. The true oral angle is the angle between the paired rays *measured in the plane containing those rays.*

When examining sagittal triradiates, spicules are very frequently found whose true oral angle is 170° and whose oral rays lie in a plane perpendicular to the optic axis. The basal ray of these spicules is usually somewhat inclined to the optic axis, usually from 10°–50°.

Among the sagittal triradiates whose true oral angle is greater than 120°, von Ebner found that in a large number of cases, when the spicule was viewed as a projection in a plane at right angles to the optic axis, that the angle then seen between the oral rays was one of 120°. In many cases, however, he found that the projection of the oral angle in such a plane produced an angle greater than 120°, usually from 150° to 180°.

He therefore divided all sagittal triradiates into two classes distinguished by the size of the "Projections Oralwinkel" in a plane at right angles to the optic axis: (*a*) those in which the angle was 120°; (*b*) those in which it was greater.

The very close similarity of this optical series of modifications with the morphological modifications here described in *Grantilla* can at once be seen. Viewing the tubar triradiates of *Grantilla* in the primitive facial plane, they can be divided into those in which the primitive oral angle is less than, equal to, or greater than 120°. The first two of these divisions includes the prochiacts, while all the secondary triradiates will be placed in the other.

It must, however, be observed that the two cases are not equivalent, since in one case the spicule is orientated with regard to its optic axis, and in the other case with regard to its morphological axis.

If the theory put forward in this paper is accepted, the prochiacts and secondary sagittal triradiates of *Grantilla* are derived directly from an already formed spicule by an actual change in the morphological orientation of the spicule during its growth. Such a change, whether of the whole spicule or of one ray, must obviously cause a similar change in the position of the

optic axis of the spicule or ray, as it is impossible to imagine that the crystal components of an already formed spicule should change their position in the spicule as it turned, so as to retain the primitive orientation in the sponge of their optic axis.

Thus the morphological movement of the spicule would not affect its orientation with regard to the optic axis, though it is very possible that the morphological movement might tend to influence the physical orientation of the calcite, which quite possibly might continue to be laid down in its primitive orientation with regard to the sponge rather than with regard to the spicule.

From a polariscopic examination of the actual prochiacts and secondary triradiates, it appears that the orientation of the spicule about its optic axis varies very greatly, but whether these variations are related in any manner to the morphological characters of the spicule, or to the amount of the widening of the primitive oral angle, I am unable to say.

In connection with the morphologically secondary sagittal triradiates of *Grantilla* and the entire replacement in this genus of the primitive articulate tubar skeleton by such spicules or by prochiacts, it is noteworthy that, leaving out of account *Megapogon*, which has a leuconoid canal-system and an irregular spicule arrangement, there are but two genera in the families Chiphoridæ and Staurorrhaphidæ which retain their articulate tubar skeleton.

In *Streptoconus* the chiactines form the gastral joint of the articulate tubar skeleton, the upper joints being composed of typical sagittal triradiates. In *Grantiopsis* the tubar skeleton, save in so far as the chiactines are concerned, is composed of triradiates which have undergone a considerable modification, the paired rays of the spicule having almost disappeared, and being only represented by minute projections at the gastral end of the spicule. In all the other genera of these two families the tubar skeleton is entirely composed of the chiactines, with in some species the very occasional addition of a triradiate, presumably from its position a remnant of the articulate tubar skeleton.

A similar replacement occurs in the Heteropidæ by means of subdermal and subgastral secondary sagittal triradiates. Very frequently in this family again the loss of the primitive tubar spiculation is complete, in which case there is formed an inarticulate tubar skeleton. As typical examples of this may be mentioned *Grantessa stauridea* and *Grantessa simplex*.

Among the syconoid Amphoriscidæ the replacement of the tubar skeleton is characteristically by large quadriradiates and triradiates. In *Amphoriscus* and *Syculmis*, for example, there are present subdermal and subgastral quadriradiates whose apical rays point respectively gastral- and dermalwards, while in *Heteropegma* the former alone are present. In all these forms the spicules of the articulate tubar skeleton are very considerably reduced, the reduction in size being very especially noticeable in some species of *Heteropegma*.

The remarkable consistency with which, throughout these families, the primitive tubar spiculation is replaced by spicules which, though of various kinds, are in every case derived from cortical triradiates, seems to me to be very strong evidence in support of the true phylogenetic unity of the group.

This view of the evolution of the more highly organized families of the Heterocœle Calcarea differs from that suggested by Dendy (2) only in the derivation of the Heteropidæ and Amphoriscidæ, not directly from the Grantidæ, but as an entirely separate line from Sycettid (*i. e.* non-corticate) ancestors. This modification has been rendered necessary by the undoubtedly primitive character of the prochiact, and the important part which it is considered to have played in the evolution of the group.

GRANTILLA QUADRIRADIATA, sp. n. (Pl. **19.** figs. 1, 2.)

The sponge is represented by a fragment only (Pl. **19.** fig. 1), of a single sycon person, possessing neither osculum nor attachment, so that a full description of its external form is impossible. The specimen is cylindrical in form, and measures 12 mm. in length and 26 mm. in diameter at the widest part.

The canal-system is typically syconoid, and the chambers do not appear to be at all branched (Pl. **19.** fig. 2).

The skeleton arrangement of the chamber layer is of the inarticulate tubar type, composed of sagittal triradiates and prochiacts on both surfaces, and also of subdermal quadriradiates, and a few oxea.

Dermal and gastral cortices are present, each containing tangentially arranged triradiates.

Skeleton arrangement. (Pl. **19.** fig. 2.)

A. Dermal cortex.

The spiculation of the dermal cortex, which is fairly thick, consists entirely of triradiates (text-fig. 2, *e*). These are fairly large, typically quite regular, with their rays of equal length, though many of them show a slight differentiation of their angles into oral (the largest) and paired, in which case the basal ray is usually very slightly longer than the oral. All the rays are equal in thickness. They are arranged over the surface of the sponge entirely without regard to orientation, except that they are placed tangentially.

B. Tubar skeleton (Text-fig. 2, *a*, *b*, *c*, *d*).

(i.) Quadriradiates (Text-fig. 2, *c*).—These are the only quadriradiates present in the sponge, and are large subdermal quadriradiates, whose facial rays are decidedly sagittal, the two oral rays being usually nearly in a straight line and the oral angle almost 180°. The apical ray is considerably the longest, frequently being nearly three times as long as the facial rays. It is quite straight and of the same diameter for most of its length, the diminution in thickness being confined to the distal third of its length.

All the three facial rays are of approximately the same length and diameter, the basal being sometimes slightly longer than the two oral. All the facial rays are slightly curved; they taper slowly for the most part of their length, and are usually somewhat abruptly pointed.

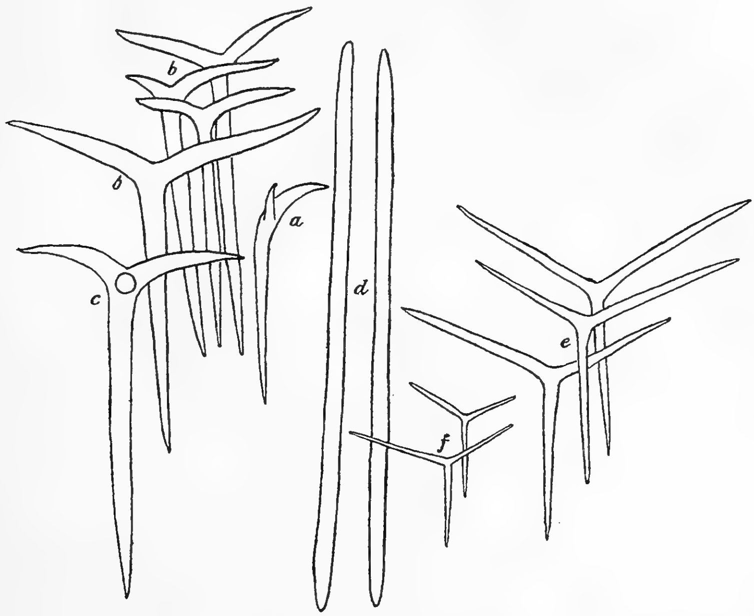


Fig. 2.—Spicules of *Grantilla quadriradiata*, all ×60.

(ii.) Triradiates (Text-fig. 2, *a*, *b*).—The subgastral elements of the inarticulate tubar skeleton are very largely prochiacts (text-fig. 2, *a*) of typical form, with a few intermediate forms, and true sagittal triradiates with them (text-fig. 2, *b*). The subdermal skeleton also contains a very considerable number of prochiacts, though here the number of sagittal triradiates is proportionately very much larger, forming about one-half of the total number of subdermal spicules. Intermediate forms also occur fairly numerously, so that the prochiacts do not on that side amount to more than one-third of the total number of subdermal triradiates.

The paired rays of both prochiacts and sagittal triradiates are usually curved, and frequently are not quite equal, either in length, or inclination to the basal ray. This is much more marked in the triradiates than in the prochiacts. The rays in each case taper gradually for the greater part of their length, and rapidly for the distal fourth of their length.

The basal ray is very much the longest, reaching to as much as three times the length of the oral rays, and is quite straight. It tapers gradually for its whole length, but somewhat more rapidly in the distal portions. All three rays are of the same diameter.

(iii.) Oxea (text-fig. 2, *a*).—A very few oxea occur, radially arranged, and traversing the sponge-wall from cortex to cortex, though they do not project from the surface. They are of almost the same diameter throughout their length, and their ends are bluntly pointed. They are quite straight or nearly so.

C. Gastral cortex (Text-fig. 2, *f*).

The spicules of the gastral cortex are all triradiates and are considerably smaller than the dermal. They form a dense layer over the gastral ends of the chambers, and are arranged entirely without orientation. They do not show any definite distinction into basal and oral rays, but all three rays are frequently of slightly different length. The length of the rays is extremely variable ; but the diameter is fairly constant and equal for all the rays of one spicule. The gastral cortical spicules are much more slender than those of the dermal cortex, and their rays shorter.

Spicular measurements (in millimetres).

	Basal rays.	Oral rays.	Apical rays.	Diameter.
Dermal triradiates	0·38 to 0·42	0·33 to 0·40	..	0·035 to 0·04
Subdermal quadriradiates	0·23 to 0·26	0·23 to 0·25	0·5 to 0·65	0·035 to 0·345
Subdermal triradiates (and subgastral).............	0·5 to 0·65	0·18 to 0·23	..	0·034 to 0·042
Gastral triradiates	0·17 to 0·28		..	0·02
Oxea.....................	1·2 to 1·3	..	..	0·03

The single specimen in the collection was obtained from the Harbour at Suez.

Distribution. Red Sea.

GRANTILLA HASTIFERA, sp. n. (Pl. 19. figs. 3, 4.)

The specimen (fig. 3) consists of a cylindrical syconoid person with a single apical osculum. The aboscular end is broken, and close to the osculum the proximal portion of a second sycon person joins on to the first ; the second tube, however, is only a fragment.

The specimen measures 22 mm. long by 9 mm. diameter at the widest part.

The tubar skeleton is inarticulate, and is composed chiefly of prochiacts and sagittal triradiates, the oral rays of the latter being of unequal length. A number of radially disposed oxea also occur, whose outer ends project considerably from the sponge, and are "semi-hastate," *i. e.* barbed on one side only.

The canal-system is typically syconoid, the chambers being protected by a fairly well-developed dermal cortex, containing a dense layer of triradiates.

Skeleton arrangement. (Pl. **19**. fig. 4.)

A. Dermal cortex.

The spiculation of the dermal cortex consists entirely of regular to subregular triradiates (text-fig. 3, *c*), which usually have the basal ray slightly longer than the paired rays. The oral angle is also usually somewhat greater than the paired angles, but many of the spicules appear to be absolutely regular. The oral rays are usually straight, but may be slightly curved. The basal ray is quite straight. All three rays are of the same thickness, and taper very gradually till near the end, most of the diminution of thickness occurring in the distal third of the ray. They lie in the cortex entirely without orientation.

B. Tubar skeleton.

(i.) Triradiates (Text-fig. 3, *a*, *b*).—The tubar skeleton is almost entirely composed of prochiacts, intermediate forms and sagittal triradiates, all being present in both subdermal and subgastral layers.

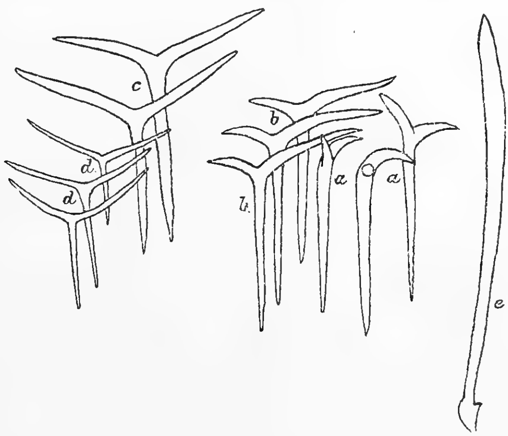


Fig. 3.—Spicules of *Grantilla hastifera*, all ×60.

The prochiacts (text-fig. 3, *a*) are much more numerous in the subgastral than in the subdermal layer, where they but occasionally appear. The paired rays are equal in length and as a rule about one-third of the length of the basal ray ; they are curved very considerably, and taper throughout their whole length. The basal ray is quite straight, and likewise tapers through its whole length. All the rays are of equal thickness.

The intermediate forms between prochiact and sagittal triradiate spicules also have approximately equal oral rays, and the measurements given below for the prochiacts apply equally to them.

The sagittal triradiates (text-fig. 3, *b*), however, show a peculiar modification of their paired rays, which are of unequal length, one of them being very nearly twice as long as the other in a typical specimen, while sometimes

it may even reach to two and a half times as long. These elongated rays do not lie in any special direction, but point towards any part of the sponge indiscriminately, two adjacent spicules frequently having their elongated rays pointing in opposite directions. The shorter of the two paired rays is of about the same length as the paired rays of the prochiacts. Both the paired rays are strongly curved, and are somewhat abruptly pointed. The basal ray is quite straight and tapers almost uniformly from base to apex, the tapering being slightly more rapid towards the point.

(ii.) Oxea (Text-fig. 3, *e*).—There are present radially arranged oxea, extending completely through the sponge-wall and with the distal third of their length projecting from the surface of the sponge. They are slightly curved, and thickest about one-third of their length from the inner (gastral) end, which is abruptly pointed. The distal end, towards which the spicule gradually tapers, is swollen into a head, whose proximal part is barbed on one side and rounded on the other. The distal end of the head is pointed.

C. Gastral cortex (Text-fig. 3, *a*).

The gastral cortex is extremely thin, and, like the dermal cortex, contains triradiates only of subregular shape. All the rays are equal in length, but there can always be distinguished two oral rays and a basal ray by the inequality of the angles. Some of the spicules have the paired rays quite straight, with the oral angle slightly larger than the paired angles, while in others the paired rays at their point of origin lie almost in one straight line, with an oral angle of nearly 180°, afterwards bending considerably so as to make the angles between the distal parts of the rays nearly equal. All the rays taper gradually from base to apex.

Spicular measurements (in mm.).

	Basal ray.	Oral rays.	Diameter.
Dermal triradiates	0·27 to	0·30	0·03 to 0·035
Subdermal and subgastral do. ..	0·32 to 0·35	(*a*) 0·2 to 0·3 (*b*) 0·1 to 0·12	0·03
Prochiacts	0·4 to 0·45	0·1 to 0·12	0·025 to 0·03
Gastral cortical triradiates	0·18 to	0·24	0·015 to 0·018
Oxea	1·0 to 1·1		0·03 to 0·04

A single specimen of this species was obtained at Suez.

Distribution. Red Sea.

This species has been placed in the genus *Grantilla* with the previous species owing to the striking similarity between their tubar skeletons, although no quadriradiates occur in this species.

Family HETEROPIDÆ, *Dendy*.

GRANTESSA GLABRA, sp. n. (Pl. **19**. figs. 5, 6.)

The specimen (fig. 5) consists of an irregular syconoid individual with a slight division into two persons indicated at one end. Each of these persons has a distal osculum, one of them being closed.

In the aboscular portion of the sponge is a large rent, so that it is impossible to say definitely that the sponge is not colonial in form. The specimen measures 20 mm. in length and 9 mm. in breadth.

The canal-system (Pl. **19**. fig. 6) is typically syconoid, with fairly thick dermal and gastral cortices, and is supported by an inarticulate tubar skeleton, composed of large, typically sagittal triradiates, and a few oxea (fig. 6).

Skeleton arrangement. (Pl. **19**. fig. 6.)

A. Dermal cortex.

The spiculation of the dermal cortex consists entirely of triradiates (text-fig. 4, *b*), which are large and vary in shape from regular to slightly sagittal, very frequently with the basal ray somewhat longer than the others. They are disposed in an irregular layer over the dermal surface, without regard to orientation. The rays are all of equal thickness, but some spicules are found in which the rays are much thicker than in others. The rays taper from base to apex, and are quite straight.

B. Tubar skeleton.

(i.) Oxea (Text-fig. 4, *d*).—The oxea, many of which have the form of the stylotes of *Monaxonida*, are straight and radially placed on the sides of the flagellated chambers amid the triradiates of the tubar skeleton with their pointed ends dermalwards. They are extremely few in number. A few oxea are also found in which the gastral end of the spicule is considerably more sharply pointed than in the typical example. They are thickest about the middle, whence they taper slightly towards the rounded gastral end, and more rapidly towards the dermal end.

(ii.) Triradiates (Text-fig. 4, *a*).—Large sagittal triradiates forming an inarticulate tubar skeleton in which, however, many of the triradiates, both in the subgastral and subdermal layers, have their paired rays placed considerably more deeply than have others. The basal ray is by far the longest of the rays, being very frequently almost twice as long as the paired rays, which are sometimes slightly unequal in length. The basal ray is quite straight. The angles between the rays are all equal at first, but the paired rays almost immediate curve outwards to form a typical sagittal spicule.

All the rays taper from base to apex.

C. Gastral cortex.

The spiculation of the gastral cortex is entirely made up, like that of the dermal cortex, of a layer of triradiates (text-fig. 4, *c*). They are equiangular,

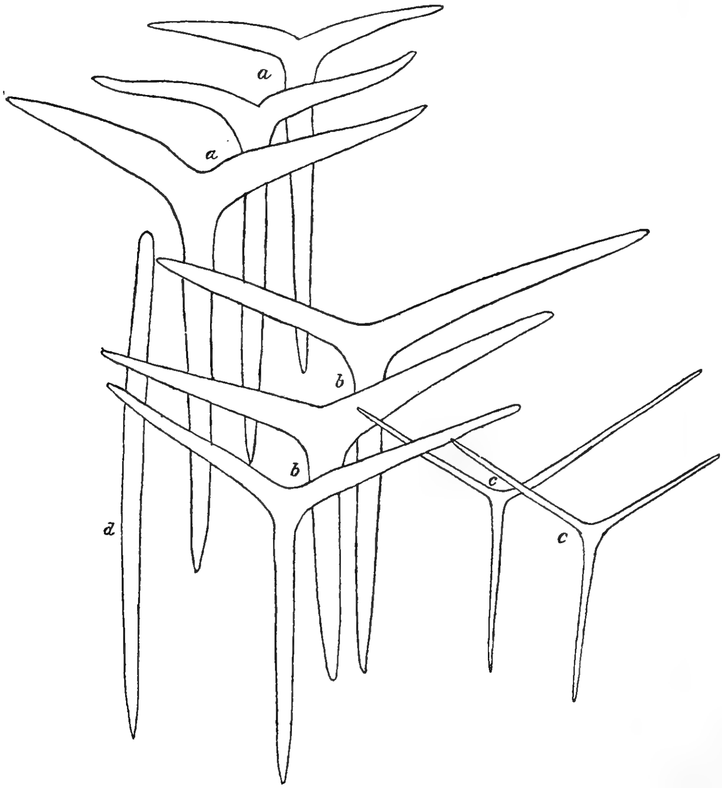


Fig. 4.—Spicules of *Grantessa glabra*, all ×60.

and their rays are somewhat less in length than those of the dermal triradiates. They are also very much more slender, being not more than a fourth of that of the larger dermal triradiates. Their rays often show a slight variation in length, and are quite straight. They taper from the base to the apex.

Spicular measurements (in mm.).

	Basal ray.	Oral rays.	Diameter.
Dermal triradiates	0·5 to 0·7	0·5 to 0·65	0·04 to 0·065
Gastral triradiates	0·4 to 0·5		0·015
Tubar triradiates....................	0·75 to 0·8	0·4 to 0·5	0·07 to 0·09
Oxea	1·0 to 1·1		0·05 to 0·06

A single specimen of this species was obtained at Suez.
Distribution. Red Sea.

Family Amphoriscidæ, *Dendy.*

Leucilla bathybia (*Haeckel*).

Synonymy;
1872. *Leucaltis bathybia,* Hæckel (**8**).
1877. *Leucaltis bathybia,* Schuffner (**16**).

Three specimens were obtained from a buoy in Suez Harbour.
Distribution. Red Sea; Amirante Is., Australia.

Leucilla intermedia, sp. n. (Pl. **20**. fig. 7.)

The specimens in the collection are small, irregularly massive, and usually with a single osculum at the top; there are no specimens present in which two oscula occur. They vary in diameter, the largest being 8 mm. at its widest part, which is close to the base.

The canal-system is sylleibid, with slightly elongated flagellated chambers arranged in groups round wide exhalant canals (Pl. **19**. fig. 7).

The spiculation of the chamber-layer is irregular.

Skeleton arrangement. (Pl. **19**. fig. 7.)

A. Dermal cortex.

(i.) Quadradiates (Text-fig. 5, *a*).—Large slender quadriradiates usually with the basal ray slightly longer than the paired rays, but spicules occur with the basal ray much the shortest. All the facial rays are straight and equal in diameter. They are also of the same diameter throughout nearly the whole of their length, the ends being somewhat abruptly pointed in most cases. In the case of those spicules which have a short basal ray, however, the basal ray tapers gradually throughout its length. The facial rays are not orientated in any special direction. The apical ray, which is directed gastralwards, is small and slender.

(ii.) Triradiates (Text-fig. 5, *d*).—A thin irregular layer of regular, tangentially placed triradiates occurs interspersed among the quadriradiates. The rays are straight, equal in length, and taper gradually from base to point. The spicules are scattered over the surface of the sponge without regard to orientation.

B. Gastral Cortex.

The spiculation of the gastral cortex consists entirely of small sagittal quadriradiates with extremely short apical rays (text-fig. 5, *b*). They form a dense but thin layer over the gastral surface of the sponge. The facial rays are all equal in length, and of the same diameter. They taper gradually

throughout their whole length. The basal ray is quite straight, but the paired rays are usually curved. The apical ray is much shorter and of less diameter than the facial rays. There is no orientation of the facial rays.

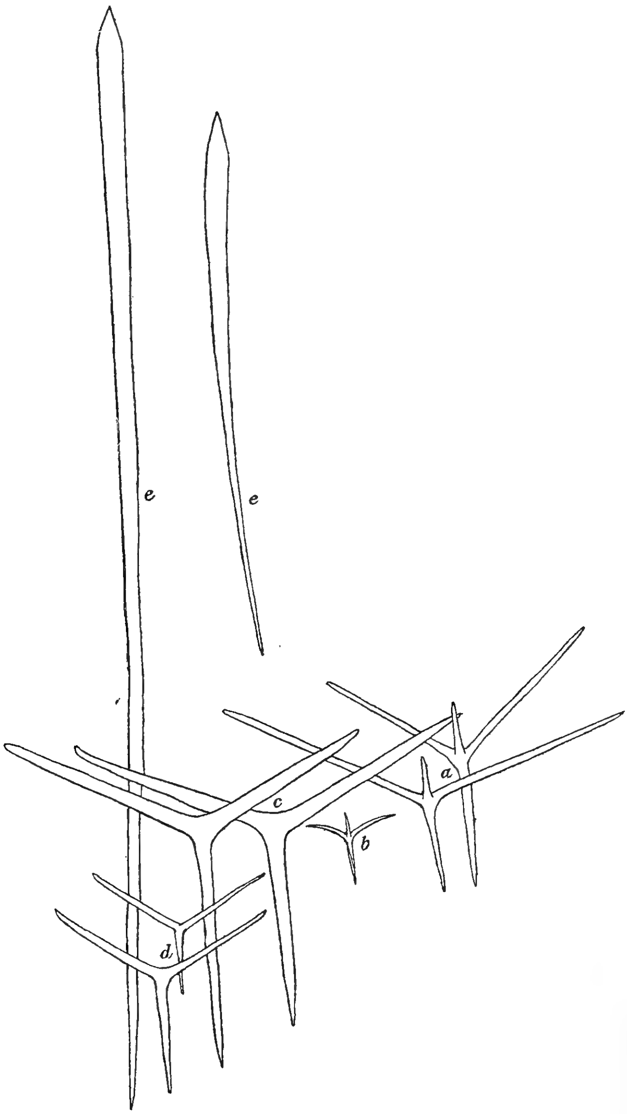


Fig. 5.—Spicules of *Leucilla intermedia*, all ×60.

C. Skeleton of the chamber-layer.

(i.) Oxea (Text-fig. 5, *e*).—The oxea are extremely long, and lie amidst the triradiates. They are arranged radially, with their distal ends projecting

some way from the surface of the sponge. They are of somewhat peculiar shape, their greatest diameter occurring near the inner (gastral) end, which is abruptly pointed. The spicules taper gradually and uniformly to the distal end, which is very elongated and slender.

(ii.) Triradiates (Text-fig. 5, *c*).—The main portion of the skeleton of the chamber-layer is composed of irregularly scattered triradiates of rather large size, all the rays being of equal length and thickness. The inequality of the angles separating the rays, however, renders it always possible to distinguish the basal ray from the paired rays. The rays are all straight and somewhat abruptly pointed.

Spicular measurements (in mm.).

	Basal ray.	Paired rays.	Apical ray.	Diameter. Facial rays.	Diameter. Apical ray.
Subdermal quadriradiates	0·17 to 0·5	0·4 to 0·5	0·12	0·015 to 0·017	0·015 to 0·016
Gastral quadriradiates	0·1 to 0·11	0·1 to 0·11	0·07 to 0·08	0·008	0·007
	All rays.			Diameter.	
Dermal triradiates	0·23 to 0·26		—	0·015 to 0·017	
Triradiates of the chamber-layer	0·37 to 0·5		—	0·03 to 0·035	
Oxea	1·0 to 3·0		—	0·05 to 0·06	

A considerable number of specimens of this sponge were obtained at Suez.

Distribution. Red Sea.

LEUCILLA CROSSLANDI, sp. n.

The specimen in the collection is but a fragment, without osculum or place of attachment. It apparently belongs to a fairly simple sponge form. It is 8 mm. long by 5 mm. broad at its widest part.

The canal-system is typically leuconoid, with small spherical chambers irregularly scattered through the sponge-wall.

The spicules are quadriradiates and triradiates.

Skeleton arrangement.

A. Dermal cortex.

(i.) Subdermal quadriradiates, of which there are two kinds:—

(*a*) (Text-fig. 6, *a*). Very large sagittal quadriradiates, lying immediately below the dermal surface. Of the facial rays there is usually a short basal ray and longer paired rays, all three rays tapering uniformly to a sharp

point from base to apex, and all being quite straight. The gastrally directed apical ray is frequently as long as the basal ray,

(β) (Text-fig. 6, *b*, *c*). Quadriradiates, not quite so large as the previous and with the paired rays slightly curved, are also present. This slight curving tends to bring the axes of the paired rays to lie nearly in a straight line. Instead of tapering uniformly and ending in a sharp point,

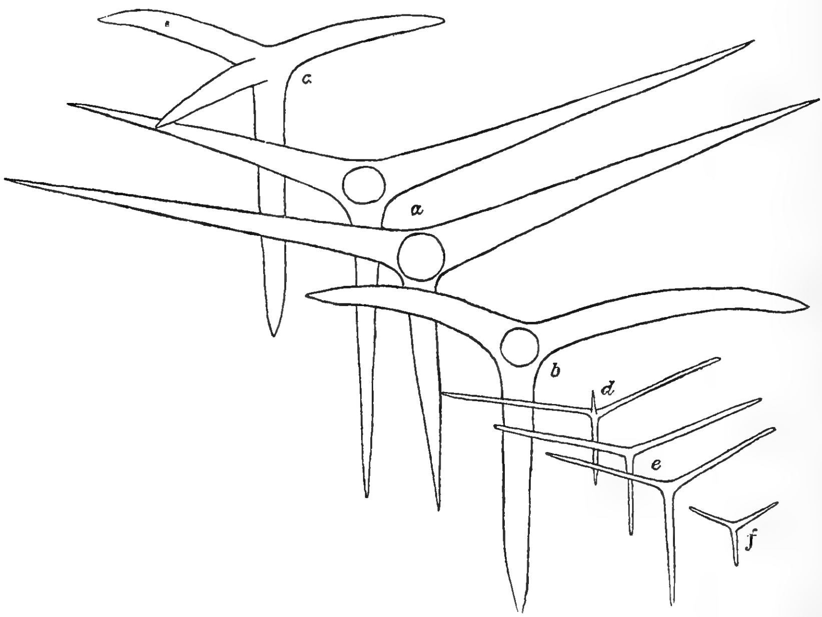


Fig. 6.—Spicules of *Leucilla crosslandi*, all ×60.

the ends are obtusely pointed, and the rays are of very nearly the same diameter for two-thirds their length. The apical ray is frequently the longest of the rays. The facial rays may be equal in length.

Measurements of subdermal quadriradiates (in mm.).

	Basal ray.	Paired rays.	Apical ray.	Diameter of rays.
α	0·61	0·92	0·55	0·1
α	0·7	0·89	0·57	0·09
β	0·6	0·6	0·58	0·09
β	0·55	0·55	0·6	0·075

(ii.) Triradiates (Text-fig. 6, *e*).—Exactly similar triradiates were found in the dermal and gastral cortices and in the chamber-layer. They are described under the skeleton of the chamber-layer. The dermal cortex is composed of a thin but very dense layer of these, filling up the interstices between the subdermal quadriradiates.

B. Gastral cortex.

(i.) Quadriradiates (Text-fig. 6, *d*). — Very slender quadriradiates with an extremely small apical ray projecting into the gastral cavity. They are sagittal, with the paired rays much longer than the basal and a very wide oral angle. All the rays are straight and the facial are all equal in diameter. The apical ray is considerably more slender than the facial rays, and tapers nearly uniformly from base to apex. The facial rays are of the same diameter for the greater part of their length and have rounded ends. The paired rays vary from 0·25 to 0·28 mm. in length, the basal from 0·18 to 0·2 mm., all three facial rays having a diameter of 0·014 mm.; the apical rays are about 0·05 mm. long, and 0·01 mm. in diameter.

(ii.) Triradiates (Text-fig. 6, *e*).—Exactly similar to those of the chamber-layer, forming a thin but dense layer among the quadriradiates.

C. Skeleton of the chamber-layer (Text-fig. 6, *e*, *f*).

This part of the skeleton consists of a great mass of sagittal triradiates scattered throughout the chamber-layer of the sponge, without orientation. There is easily distinguishable, in most spicules, a basal and two paired rays, by the great width of the oral angle. The basal ray is also usually not quite so long as the paired rays, but it may be equal to them in length or even longer than they are. All the rays are quite straight and of equal diameter almost up to the tip, which is somewhat rounded.

There are also present in the chamber-layer, though not in the dermal or gastral cortex, a quantity of very small triradiates, which may very possibly be the incompletely developed specimens of the preceding. They are sagittal and have the paired rays always slightly longer than the basal. The thickness and form of the rays are the same as in the larger triradiates.

Measurements of triradiates (in mm.).

	Basal ray.	Oral rays.	Diameter.
Large triradiates	0·2 to 0·28	0·25 to 0·30	0·014
Small triradiates	0·14 to 0·18	0·16 to 0·2	0·014

A fragment of a single specimen was obtained at Suez.

Distribution. Red Sea.

Family PHARETRONIDÆ, *Zittel*.

Subfamily DIALYTINÆ, *Rauff*.

Genus KEBIRA,* n. g.

Sponge composed of a single person with an apical osculum. The chamber-layer is covered over with a thick dermal cortex, in which occur numerous large oxea, longitudinally arranged. The spicular fibres are composed of triradiates, the paired rays of which are vestigial. The fibres lie radially disposed, or inclined but little to the radial direction, in the chamber-layer. The canal-system is leuconoid, with large subdermal cavities, inhalant and exhalant canals.

This genus is of unusual interest not only as a living member of the family Pharetronidæ, an almost wholly fossil group, but also on account of the presence of triradiates of very peculiar type.

In the only other known living genus belonging to the subfamily Dialytinæ, *Lelapia* (**2** *a*), there also occur fibres of modified triradiates, in this case tuning-fork spicules, the paired rays being bent towards each other so that they come to lie parallel and close together, and almost in line with the basal ray. Thus the spicular fibre comes to be composed of spicules simulating oxea.

In *Kebira*, however, the same result is obtained by a totally different method. Here, at first sight, the spicules of the fibres appear to be true oxea, but on more careful observation it is found that there is present on the inner (gastral) end of each, a small triangular head or swelling representing the two paired rays (text-fig. 8, *e*). Although typically almost absent, yet there occasionally appear considerable rudiments of these paired rays, especially at the gastral end of the spicular fibre, where there are no surrounding spicules. All the paired rays are turned gastralwards, and the fibres run either radially, or very slightly inclined to the radial direction (Pl. **20.** fig. 9).

It must be noted that where sufficient vestiges of the oral rays are present for their true shape and position to be made out, they are seen to be typically sagittal and to show no signs of turning inwards to form a tuning-fork spicule, so that it is not possible to derive them from tuning-fork spicules by the loss of the paired rays.

KEBIRA UTEOIDES, sp. n. (Pl. **20.** figs. 8, 9.)

Sponge of well defined flask-shape (Pl. **20.** fig. 8) with a thick dermal cortex containing large longitudinally placed oxea. Dermal surface covered by a

* The name is taken from the locality where it was obtained—Tella Tella Kebira.

Fig. 7.—Oxea of *Kebira uteoides*, ×60.

sparse layer of sagittal triradiates arranged tangentially. Gastral surface covered with a thin layer of subregular triradiates. Surface of the sponge smooth and not marked by ridges or depressions. There is a single osculum at the upper end—not guarded by any fringe or collar.

The canal-system is typically leuconoid and possesses a series of shallow, but somewhat broad, subdermal cavities, from which inhalant canals lead to the chambers. From the chambers wide exhalant canals lead to the gastral cavity (Pl. **20**. fig. 9).

I have been unable to distinguish the openings from the exterior to the subdermal spaces, but the arrangement of skeleton of the dermal cortex leads me to think that probably they are in the form of very numerous minute pores irregularly scattered over the surface of the sponge. No special pore areas were observed on the surface.

The arrangement of the skeleton is shown in Pl. **20**. fig. 9.

The spicules are of two kinds, oxea and triradiates.

(*a*) Oxea (Text-fig. 7).

The oxea are extremely large, and occur in great quantities in the very thick dermal cortex covering the sponge. They are thickest in the middle, and gradually taper towards the ends. Their shape is more or less curved, according to the part of the body in which they occur, and the contour of which they follow, so that at the oscular end of the body, those of them which project into the oscular rim (fig. 7 *b*), which is very low, and not definitely marked off from the rest of the body, have their ends slightly bent in the reverse direction to the general curve of the spicule.

They vary very greatly in length, being found in all stages of growth, so that the smallest observed specimen measures scarcely ·2 mm. long, while all intermediate stages are

found between this and the largest specimens which measure anything up to 4 mm. The diameter of the largest specimens at their thickest part varies from ·15 to ·18 mm.

(*b*) Triradiates.

(i.) Dermal (Text-fig. 8, *c*).—The triradiates of the dermal layer are of small dimensions and all markedly sagittal, with the paired rays two or three times as long as the basal. They form a sparse, but even covering, dermad to the oxea, over the whole of the external surface of the sponge, except in the immediate region of the oscular rim, where apparently they have not yet developed. The rays are all equal in diameter right up to their tips, which are rounded. The basal rays are straight, the apical curved. They are scattered over the surface without regard to orientation.

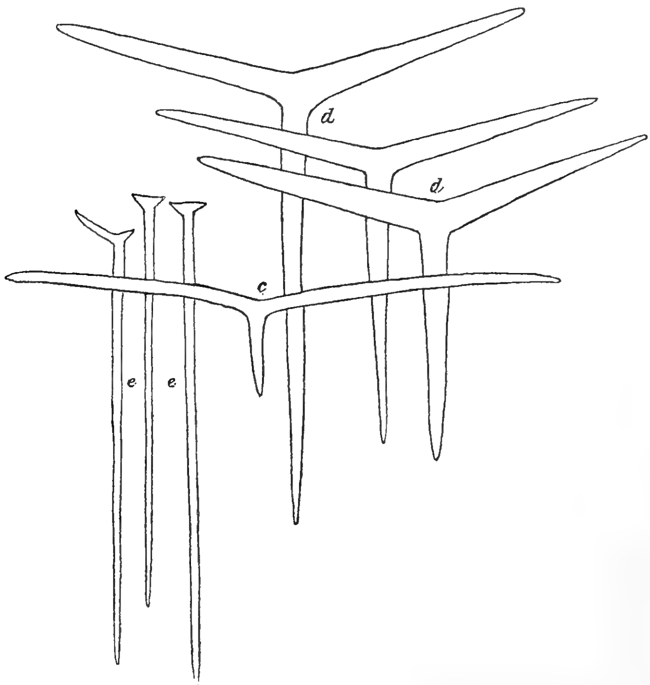


Fig. 8.—Triradiates of *Kebira uteoides*, *c* and *d* ×160, *e* ×310.

(ii.) Gastral (Text-fig. 8, *d*).—A thin gastral cortex is present between the flagellated chambers and the gastral cavity, in which there lies a layer of triradiates. These spicules are regular or slightly sagittal, but nearly all have the basal ray longer than the paired rays, in the sagittal specimens considerably so. All the rays are straight and of the same diameter. The ends are rounded.

Measurements of a series of triradiates is given below (in mm.) :—

	Paired rays.	Basal ray.	Diam. at base.
Gastral cortex	0·19	0·4	0·023
"	0·195	0·21	0·03
"	0·2	0·23	0·016
"	0·13	0·15	0·023
Dermal cortex	0·24	0·076	0·015
"	0·22	0·091	0·015

(iii.) Spicular fibres.—The fibres are composed of remarkable triradiates (text-fig. 8, *e*), usually having their oral rays reduced to a small triangular head at the end of the basal ray. The only other calcareous sponge having spicules of this shape is *Grantiopsis cylindrica*, Dendy, one of the Staurorrhaphidæ, in which the spicules of the articulate tubar skeleton are reduced to an exactly similar form.

These "*nail-spicules*," as I propose to call them, form long fibres extending through the whole width of the chamber layer, and arranged radially or very slightly inclined to the radial direction. A cross section of a fibre will nearly always show from 3 to 5 spicules, four being the most frequent number. At the gastral ends of the fibres the "nail-heads," *i. e.* the vestigial paired rays, show a tendency to increase their size, and also occasionally the spicules at the sides of the fibre have enlarged "heads." It is very frequent, in this case, to find that one of the paired rays is developed much more than the other.

The length of the basal ray varies from 0·18 to 0·22 mm., and its diameter from 0·003 to 0·0035 mm. The head typically measures 0·008 to 0·01 mm. in diameter, but individual oral rays have been noticed as long as 0·02 mm. When the length of the oral rays is sufficiently great to enable their diameter to be measured, they are found to be equal in width to the basal ray.

The single specimen in the collection was obtained at Tella Tella Kebira.

Distribution. Red Sea.

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(19) VON EBNER, V.—"Ueber den feineren Bau der Skelettheile der Kalkschwämme &c." Sitz. der kais. Akad. der Wissensch., Bd. xcv. Abt. i., 1887.
(20) MINCHIN, E. A.—"Materials for a Monograph of the Ascons." Q. J. M. S. vol. lii., 1908.

EXPLANATION OF THE PLATES.

PLATE 19.

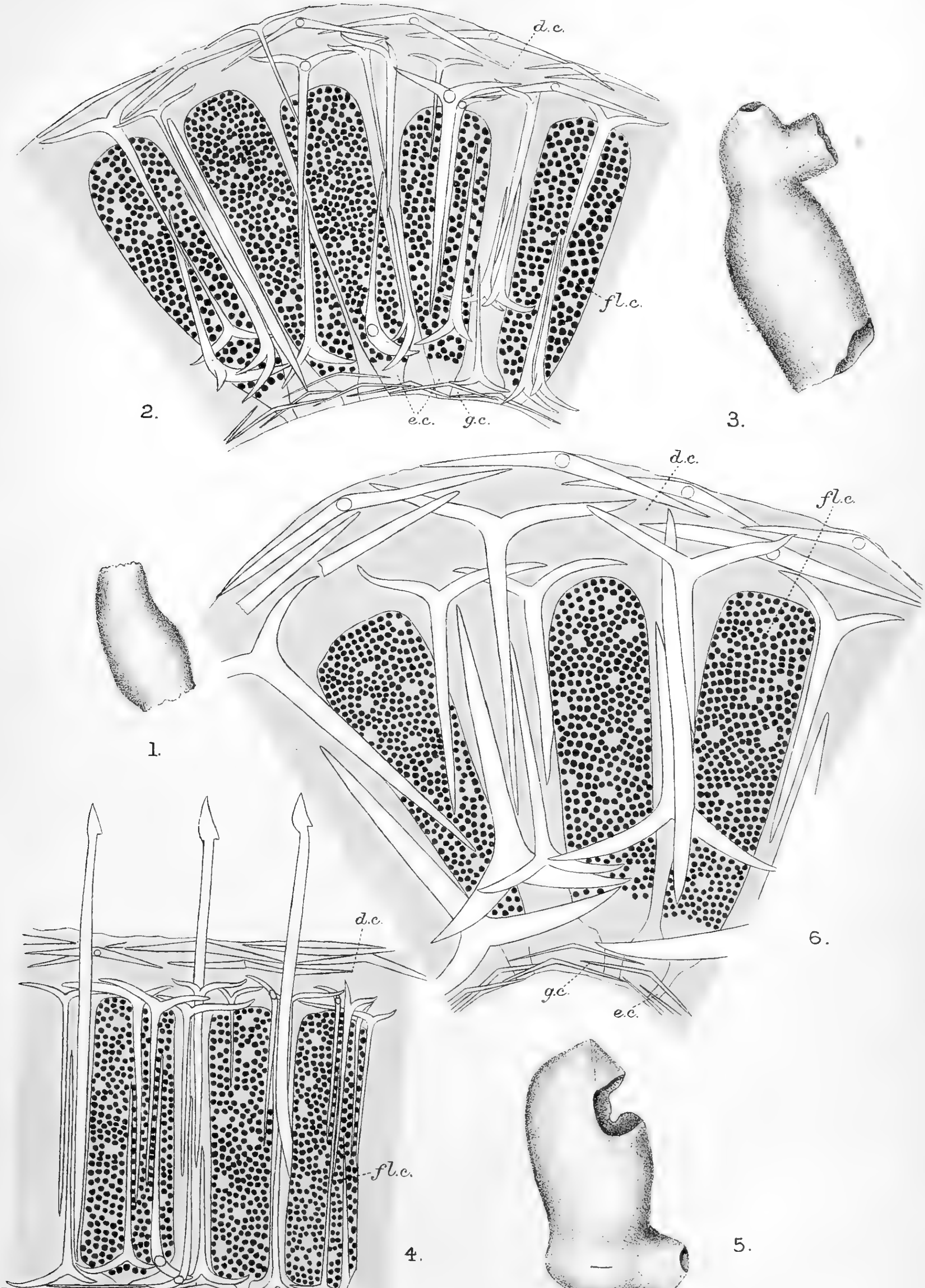
Fig. 1. *Grantilla quadriradiata.* External form. ×2.
2. „ „ Transverse section through sponge-wall. ×60.
3. „ *hastifera.* External form. ×2.
4. „ „ Transverse section through sponge-wall. ×60.
5. *Grantessa glabra.* External form. ×2.
6. „ „ Transverse section through sponge-wall. ×60.

PLATE 20.

Fig. 7. *Leucilla intermedia.* Transverse section through sponge-wall. ×60.
8. *Kebira uteoides.* External form. ×6.
9. „ „ Longitudinal section through sponge-wall. ×60.

LETTERING OF FIGS. 2, 4, 6, 7, 9.

d.c., dermal cortex. *g.c.*, gastral cortex.
e.c., exhalant canal. *i.c.*, inhalant canal.
fl.c., flagellated chamber. *s.d.c.*, sub-dermal cavity.
sp.f., spicular fibres (composed of "nail-spicules").



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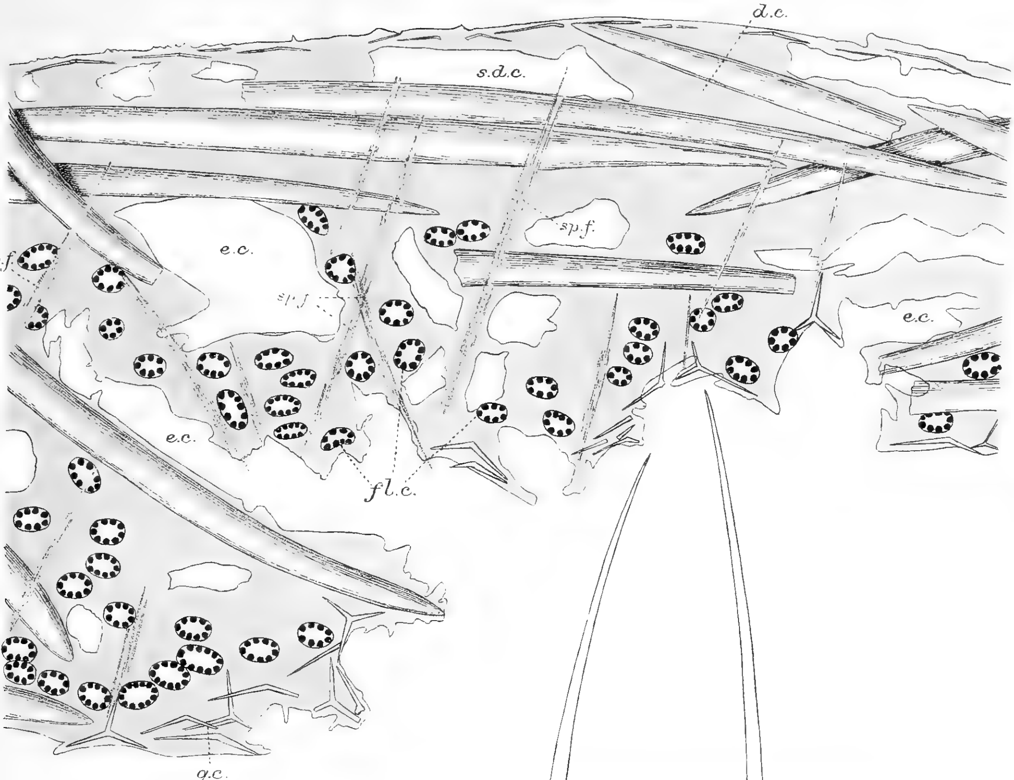

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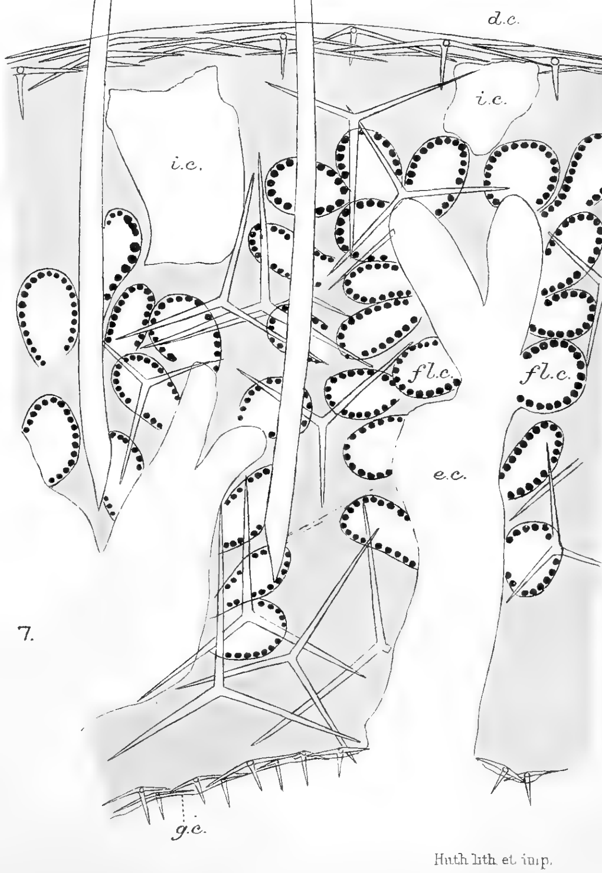

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THE JOURNAL

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REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—XIV. On the CRUSTACEA ISOPODA and TANAIDACEA. By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S., F.L.S., F.Z.S., Hon. Memb. New Zealand Institute, Hon. Fellow Worcester Coll., Oxford.

(PLATES 21–23.)

[Read 16th December, 1909.]

THE collection contains fifteen species, distributed over twelve genera. Two of the species, one as larval, the other as imperfect, are left unidentified. Of the remainder, four are regarded as new and present points of interest noted in the several accounts relating to them. Three of the four new species are based on specimens of very small size. In one case only a single specimen was available, and where the largest number was in hand, all three specimens were imperfect. Under these circumstances the collection may be regarded as having yielded a fairly creditable result, especially as it was made in a part of the world where investigators have been frequently at work.

Tribe *CHELIFERA.*

Family TANAIDÆ.

Genus TANAIS, *Audouin & Milne-Edwards.*

1828. *Tanais,* Audouin & Milne-Edwards, Précis d'Entomologie, p. 46, pl. 29. fig. 1.
1905. *Tanais,* Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 2.
1905. *Tanais,* H. Richardson, Bull. U.S. Nat. Mus. No. 54, p. 7.

TANAIS PHILETÆRUS, *Stebbing.*

1904. *Tanais philetærus,* Stebbing, Spolia Zeylanica, vol. ii. pt. 5, p. 7, pl. 2.

A female specimen, having the bilaminar and very prominent marsupium loaded with eggs, shows no characters that would justify its separation from the species named. The thumb of the first gnathopods is oval, instead of having an irregular inner margin, but the armature is similar to that of the male, the inner border being fringed with setæ, here six in number, and the apex carrying a short strong spine. The eyes and antennæ and three pairs of pleopods agree with those of the male. The uropods are four-jointed, and here the first or peduncular joint is a little longer than any one of the three subequal flagellar joints.

Length 2·5 mm.

Locality. Label: Crustacea, Quay wall, Dec. 04, Crossland coll.

Genus Leptochelia, *Dana.*

1849. *Leptochelia,* Dana, Amer. J. Sci. ser. 2, vol. viii. p. 425.
1900. *Leptochelia,* Stebbing, Willey's Zoological Results, pt. 5, p. 614.
1904. *Leptochelia,* Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 5.

Numerous references to the bibliography of this genus will be found under the last two dates.

Leptochelia minuta, *Dana.*

1853. *Leptochelia minuta,* Dana, U.S. Expl. Exp. vol. xiii. p. 800, pl. 53. figs. 5 *a–d.*
1900. *Leptochelia minuta,* Stebbing, Willey's Zoological Results, pt. 5, p. 615.

Four specimens of the male sex, in length about 2·5 mm., agree closely with Dana's figures. They are well distinguished from *L. mirabilis*, of Professor Herdman's expedition, not only by much inferior size, but also by he second joint of the upper antennæ, which is here barely twice, instead of eight times, as long as the third. The flagellum is eight-jointed. Along with these male specimens were several others, ranging from 2 mm. to 3·75 mm. in length, without the characteristic gnathopods of the adult male, and some of them declaring their sex by having eggs in the marsupium.

Locality. Label : 25/3/05 : Crustacea lec., amg. *M. vulg.* shells.

Leptochelia lifuensis, *Stebbing.*

1900. *Leptochelia lifuensis,* Willey's Zoological Results, pt. 5, p. 616, pl. 65 b, ♂, pl. 64 c, ♀.

A single specimen of the adult male with the characteristic first gnathopods occurred in the collection. The gnathopods in question are substantially constructed as well as elongate, with a wide gap left between the finger and the strongly bidentate thumb, when they meet. In this specimen the uropods have the longer ramus five-jointed, but the shorter one-jointed, not two-jointed as in the typical specimens.

Locality. Suez docks, among broken shells, 7/12/4. At a locality labelled 04/5, 11 Misc. 30, several specimens occurred which are probably the females or young males of this species. Some of these had the four pairs of marsupial plates well developed. A few also occurred along with *Tanais philetærus* above mentioned, and a single larval specimen of *Gnathia.*

Tribe *Flabellifera.*

Family Eurydicidæ.

Genus Cirolana, *Leach.*

1818. *Cirolana,* Leach, Dict. Sci. Nat. vol. xii. p. 347.
1905. *Cirolana,* Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 11.

For bibliography of the genus, see the last reference.

CIROLANA PARVA, *H. J. Hansen.*

1890. *Cirolana parva*, Hansen, Vid. Selsk. Skr. ser. 6, vol. iii. pp. 321, 340, pl. 2. figs. 6–6*b*, pl. 3. figs. 1–1 *d*.
1905. *Cirolana parva*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 12.
1905. *Cirolana parva*, H. Richardson, Bull. U.S. Nat. Mus. No. 54, p. 111, figs. 93–95.

The specimen of this little species showed no distinctive sexual characters. In the first antennæ the flagellum is six-jointed, in the second thirteen-jointed. The apex of the telsonic segment is bordered with eight spines, not, indeed, on the outer case, which was almost denuded of its fringe, but on that prepared for the moult, which came away clear in dissection.

The length of the specimen was 4·5 mm., with a breadth of 1·25 mm.

Locality. Label: Crossland 04/5, 11 Misc. 30.

Family CORALLANIDÆ.

Genus LANOCIRA, *Hansen.*

1890. *Lanocira*, Hansen, Vid. Selsk. Skr. ser. 6, vol. v. pt. 3, pp. 287, etc.
1904. *Lanocira*, Stebbing, in Gardiner's Fauna of the Maldive and Laccadive Archip vol. ii. pt. 3, p. 706.
1905. *Lanocira*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 19.

The four species of this genus already described are closely related one to the other, and the species now to be added is evidently a near ally of the rest. It belongs to the group in which the hinder part of the body is setigerous, and agrees with the form which I have named *L. gardineri* in having a frontal process to the head of the male. The process, however, is not horn-like, but distally expanded, so as to present a very distinct appearance.

LANOCIRA LATIFRONS, sp. n. (Plate **21.**)

In the male the front of the head is produced into a broad, slightly upturned, somewhat axe-like process, of which the widened distal portion while *in situ* appears to be truncate in dorsal view, but is seen to have a curved outline when the head is detached. In the female there is only a broad shallow convex projection, in no way axe-like. Of the peræon segments, the first is the largest, the last three are successively smaller than those which precede them. The first pleon segment is almost completely concealed, and the fifth has its outer angles much overlapped by those of the preceding segment. The telsonic segment is broader at the base than the length, that part of it which no doubt represents the telson being triangular with a rather narrowly rounded apex. The surface is pretty closely set with

numerous spines or short setæ and its serrulate margin with long setæ, among which the apex exhibits traces of six spines ; but both here and on the uropods the armature of spines and setæ, though evidently by nature ample, has suffered damage. The dorsal surface of the earlier pleon segments is microscopically squamose, but like the peræon exhibits at present very few spines.

The eyes are large and dark, have forty or more components, and are separated by an interval about equal to their shorter diameter.

The first antennæ have a seven-jointed flagellum ; the second have one that is seventeen-jointed, fringed in the male with numerous long filaments. In essentials they do not differ from those described and figured for *L. gardineri*, yet between the two members of each pair there are small differences of detail, and, as is shown in the figures, a considerable difference in appearance may result from the positions which they assume when mounted. The second antenna on the left does justice to the filaments of the flagellum, while that on the right sets out the relative breadth of the various articulations but leaves the filaments in obscurity.

The upper lip is distally emarginate. The mandibles, as usual in this genus, were very untractable. There is a massive very irregularly quadrate base, with the rest of the trunk disproportionately slender, its distal edge bifid, with a sharp tooth above, but the lower details obscure (probably agreeing with what I have figured for the mandible of *L. zeylanica*). Near the distal tooth some minute reverted denticles appear on the upper margin. The palp is affixed to the strong basal part, and has the first joint rather shorter than the second, but as long as or longer than the third.

In this species, as in *L. zeylanica*, the first maxillæ present a very powerful and strongly curved apical spine, both this and the base on which it stands differing rather notably in shape and proportions from those figured by Hansen for his *Lanocira kröyeri*. The maxillipeds differ little from those of *L. zeylanica*, but the third and fourth joints are relatively rather longer, each being longer than broad, which is not the case in any of the species previously described.

The limbs of the peræon do not offer characters of marked distinction. The fifth peræopods are somewhat more slender than in *L. zeylanica*, with the apical spines of the joints less elongate than in the male of that species.

The branches of the second pleopods are considerably narrower in proportion to their breadth than in *L. zeylanica*.

Length of male 7·75 mm., breadth about 3·5 mm.; length of female 9 mm., breadth about 4 mm.

Locality. Label : Sudan Pearl Fisheries Investigations. Isopoda (2).

LANOCIRA ZEYLANICA, *Stebbing*.

1904. *Lanocira zeylanica*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 19, pl. 5 B.

The specimens which I identify with this species were labelled as taken, Sudan Trials 1 and 44 Sudan F. E.

Family CYMOTHOIDÆ.

Genus MEINERTIA, *Stebbing*.

1893. *Meinertia*, Stebbing, History of Crustacea, Internat. Sci. Ser. vol. lxxiv. p. 354.

MEINERTIA IMBRICATA (*J. C. Fabricius*).

1787. *Oniscus imbricatus*, Fabricius, Mantissa Insectorum, vol. i. p. 241.
1884. *Ceratothoa imbricata*, Miers, Zool. Coll. H.M.S. 'Alert,' p. 300.
1900. *Meinertia imbricata*, Stebbing, South African Crustacea, pt. 1, p. 58.

Three specimens of this well-known species, but of no exceptional sizes, were obtained by the Sudan expedition, under date 11.2.05.

Family SPHÆROMIDÆ.

1905. *Sphæromidæ*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 29.
1905. *Sphæromidæ*, H. Richardson, Bull. U.S. Nat. Mus. No. 54, p. 270.
1905. *Sphærominæ* (subfam.), Hansen, Quarterly J. Microsc. Sci. vol. xlix. pt. 1, pp. 73, 100, 115.

It is worthy of notice that the three above-cited discussions of this rather perplexing family were contemporaneous and independent, a circumstance which may increase the student's confidence, at least, in those opinions which the three authors hold in common.

Genus SPHÆROMA, *Bosc*, 1802.

SPHÆROMA CONGLOBATOR (*Pallas*).

1766. *Oniscus conglobator*, Pallas, Miscellanea Zoologica, p. 194, pl. 14. figs. 18, 19.
1787. *Oniscus serratus*, J. C. Fabricius, Mantissa Insectorum, p. 242.
1802. *Sphæroma cinerea*, Bosc, Hist. Nat. des Crustacés, vol. ii. p. 186, pl. 15. fig. 8.

Bosc accepts the species which Fabricius in 1793 named *Cymothoa serrata* and *Cymothoa assimilis* as synonyms of *Oniscus conglobator*, Pallas, and proceeds to give them a new name of his own devising. Fabricius himself regarded his *assimilis* as a synonym of the species which Pallas in 1772 had renamed *Oniscus globator*. It is obvious that in the eighteenth century

naturalists were as indifferent to rights of priority as some in our own day are inclined to be. It must be owned that Linnæus had set the example.

Bate and Westwood say of this species, "young individuals, measuring not more than two lines in length, have the outer edges of the side appendages of the tail (uropoda) entire, and not serrated." Specimens from Suez, measuring when unrolled only 2·5 and 3 mm. in length, had the outer edge of the outer branch of the uropods serrate as in their larger companions, the largest of which measured 7 mm. by 3·75 mm.

Locality. Suez docks, from two old broken shells, 7.12.04.

SPHÆROMA WALKERI, *Stebbing*.

1905. *Sphæroma walkeri*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 31, pl. 7.

Numerous specimens, mostly rather small, of this well-marked species were obtained at Suez by Mr. Crossland on board the s.s. 'Thyra.'

Genus EXOSPHÆROMA, *Stebbing*.

1900. *Exosphæroma*, Stebbing, Proc. Zool. Soc. London, p. 553.
1902. *Exosphæroma*, Stebbing, South African Crustacea, pt. 2, p. 64.
1905. *Exosphæroma*, Hansen, Quarterly J. Microsc. Sci. vol. xlix. pt. 1, pp. 75, 82, 103, 116, 118.

While transferring *Sphæroma leucura*, White, and *S. stimpsonii*, Heller, to *Exosphæroma*, Hansen remarks further :—"Several of the nearly twenty species enumerated above as referred to *Sphæroma* by earlier authors, but whose systematic position I am unable to settle, will certainly prove themselves to belong to *Exosphæroma*. On the other hand, of the three species established by Stebbing as species of *Exosphæroma*, *E. validum* (Stebb.) is the immature male and *E. setulosum* (Stebb.) the female of the same species of *Cymodoce*, while *E. amplifrons* (Stebb.) is the adult male of an aberrant species of *Cymodoce*."

EXOSPHÆROMA RETICULATUM, sp. n. (Plate **22**, B.)

In comparing this species with the characters given by Hansen for the group which he designates Sphæromimæ hemibranchiatæ, and within that group with the characters distinguishing *Exosphæroma*, there is only one point of obvious disagreement. Hansen states that the exopod of the third pleopods is two-jointed. But that is not the case with the present species.

All over the back the integument shows a fine net-like structure or pattern, with some scattered setules. The head has a small rostral point. The telsonic

segment is somewhat inflated except near the sinuous side margins and the narrowed blunt apex.

The eyes are wide apart. The first antennæ have the first joint, as usual, rather massive and suggestive of a composite nature, while the next joint, probably representing the true third, is as broad as it is long. The tapering flagellum consists of eight joints, the first of which is much the longest. In the second antennæ the fifth joint, though not elongate, is longer than any of the four preceding joints; of the ten joints composing the flagellum the first and last are very short.

The upper lip on each side of its rounded border shows a dark fringe of setules. In the mandibles the molar is prominent, the cutting-edge denticulate, with a secondary plate clear on the left mandible, but rather like a bifid spine on the right; the first joint of the palp is longer than either the second or the third, the latter two carrying spine-fringes. The lobes on the fourth, fifth, and sixth joints of the maxillipeds are well marked, but short.

The first gnathopod has on the long third joint a fringe of short setæ on the hind margin, not long and natatory such as are found in the genus *Sphæroma*; on the projecting angle of its front margin there is a long spine, a similar one to which occurs on all the following limbs. These limbs are of the character usual in the genus, the longest being the fifth peræopods, between which ventrally are the pair of genital papillæ, these being, so far as my experience goes, of quite exceptional length. They are placed close together, taper each to a point, and appear to have finely crenulate margins.

The second pleopods of the male have the masculine appendage on the inner branch something like that figured by Whitelegge for his *Cerceis nasuta*, being of moderate length, comparatively broad, and quite smooth, but here the appendix is attached somewhat higher up on the branch and not straight but gently curved outwards.

The uropods in the adult male bear some resemblance to those which Haswell has figured for his *Sphæroma brevis*, a species as to which further information is requisite. Here the outer movable branch is longer and much narrower than the round-ended fixed inner branch; it is serrulate and spinulose to a greater degree than the inner, and apically has a feebly bidentate appearance. In the smaller specimen, which is devoid of male characters, this outer branch of the uropods is not longer than the inner branch.

Length of adult male 3·5 mm., breadth 1·75 mm. Smaller specimen, sex undetermined, length 3 mm., breadth 1·5 mm.

Locality. Red Sea, 1904/5, Misc. 68.

The specific name refers to the reticulate or net-like appearance of the integument as seen under the microscope.

Genus CYMODOCE, *Leach.*

1813–14. *Cymodoce*, Leach, Edinb. Encycl. vol. vii. p. 433.
1818. *Cymodocea*, Leach, Dict. Sci. Naturelles, vol. xii. pp. 341, 342.
1840. *Cymodocea*, Milne-Edwards, Hist. Nat. Crust. vol. iii. p. 212.
1902. *Cymodoce*, Stebbing, South African Crust. pt. 2, p. 73.
1905. *Cymodoce*, Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 42.
1905. *Cymodoce*, Hansen, Quarterly J. Microsc. Sci. vol. xlix. pt. 1, pp. 70, etc.
1906. *Cymodoce*, H. Richardson, Proc. U.S. Nat. Mus. vol. xxxi. p. 5.

As will be seen from Hansen's above-mentioned essay, several species, properly belonging to this genus, have previously been described under other generic names.

CYMODOCE PILOSA (*Milne-Edwards*).

1840. *Cymodocea pilosa*, Milne-Edwards, Hist. Nat. Crust. vol. iii. p. 213.
1905. *Cymodoce pilosa*, Hansen, Quarterly J. Microsc. Sci. vol. xlix. pt. 1, pp. 83, 134, pl. 7. figs. 1 *a*–2 *e*.

In the Ceylon report I have given a translation of the description of this species by Milne-Edwards, for comparison with my own accounts of the nearly allied *Cymodoce bicarinata*. The specimens from Suez which I now venture to name *C. pilosa* agree well with the original description, except that (like the male of *C. bicarinata*) they are only half the size, which may possibly be accounted for in some by their being females, but in addition they do not show the setose boss at the extremity of the median longitudinal furrow of the telsonic segment, and further the outer ramus of the uropods is not much, if at all, broader than the inner. Milne-Edwards says that these rami extend much beyond the extremity of the pleon. In the present specimens, when the pleon is folded, these rami appear to extend beyond it, but that is no longer or not always the case when it is flattened out.

The specimen first dissected proved to be a female laden with large eggs which extended from the head to the pleon. The antennæ are of the usual pattern. In the first pair the first joint is broad and long with a rounded boss at the base and a flattened lamina extending along and much beyond the boss, the two together probably representing the first and second joints in coalescence. The following joint is short and less broad, but still laminar, carrying a slender fifteen-jointed flagellum, in which the first joint is so much longer than any of the rest that it might well pass as peduncular. In the second antennæ the first three joints are rather short, not massive, the fifth joint rather longer than the fourth, which is not greatly longer than the second; the flagellum eleven-jointed. This flagellum in another specimen, with fewer eggs, was fifteen-jointed like that of the first pair.

In the mouth-organs both specimens agree closely with the account and figures given by Hansen, who for the first time has pointed out that in

some genera of this family the mouth-parts in ovigerous females are metamorphosed in a very peculiar way. In the egg-bearing females of *C. pilosa* he states that the incisive process or cutting-edge is rounded and yellowish, which shows that it is less hard than in the male, that the secondary plate has disappeared, while the molar process is very low, scarcely developed, and without equipment for trituration. The female first maxillæ, he says, have been altered in a corresponding way; the distal half of the inner lobe is much narrower than in the male, "its end rounded and the stiff setæ lost; the outer lobe has gained a number of fine hairs, but its end is rounded and of the strong terminal spines at most a rudiment and generally nothing remains." The lobes of the second maxillæ have lost all their numerous setæ found in the male and in immature specimens, and the bifid outer lobe has been shortened. "Besides, all these mouth-parts have the muscles considerably or much reduced; but the muscles to the mandibular palps, still shaped as in the males, have been preserved." The lower lip has been much reduced, being only about half as large as in the male. "The maxillipeds are still more interesting; in the female with brood . . . . the four distal joints have been reduced in size, especially the lobes are much shorter and have lost all the setæ found in other specimens . . . . ; the lobe from second joint has lost its distal setæ, but the two proximal joints with the epipod are, on the contrary, expanded to such a degree that their joint surface is between twice and three times larger than in the male of the same size; some of the muscles of the palp have been reduced in size and all are lighter in aspect, while the musculature moving the expanded proximal portion is well developed." Later on Hansen makes it clear that exact similarity among specimens with metamorphosed mouth-parts need not be expected. He says: "Of ten females with marsupium of *Cymodoce pilosa* (M.-Edw.) eight had all their mouth-parts altered as described above, but in two specimens the curious feature was observed that the maxillipeds and [second] maxillæ had been completely metamorphosed, while the alterations in the two anterior pairs of appendages were less complete. In one of these specimens the end of the mandibles had kept their dark colour and the outer lobe of both maxillulæ [first maxillæ] their spines, while lacinia mobilis [accessory plate of mandibles], etc., had disappeared; in the other specimen only a little of the dark colour on the end of the mandibles and the spines on one of the maxillulæ were preserved."

In both the Suez specimens examined the mandibles are dark, and in both the lobe from the second joint of the maxillipeds shows little spine-teeth or spinules on the inner part of the distal border. In at least one instance there are two simple spines on the narrowed apex of the outer plate of the first maxillæ. In all cases the palp of the mandibles retains the setose armature of the second and third joints, each of which is shorter than the first.

In the Ceylon report I have figured a species under the name *Cilicæa* (?),

sp. juv., and say that "The small specimen figured is no doubt immature, as may be judged from the unfurnished condition of the maxillipeds." Under the new light thrown on the subject by Dr. Hansen, it is more probable that the specimen referred to was a female.

Length, approximately the same for the four female specimens, 6·75 mm.; one 6 mm. long, probably an immature male, with the mouth-organs quite normal for that sex, but without appendix on second pleopods.

Locality. From two old broken shells, Suez docks, 7.12.04.

Tribe ASELLOTA.

Family JÆRIDÆ.

1897. *Ianiridæ,* Sars, Crustacea of Norway, vol. ii. pt. 5, p. 98.
1905. *Janiridæ,* Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 48.
1905. *Parasellidæ,* Hansen, Proc. Zool. Soc. London, 1904, vol. ii. p. 315.
1905. *Janiridæ,* H. Richardson, Bull. U.S. Nat. Mus. No. 54, p. 448.

In 1897 Sars divided his tribe Asellota into the five families, Asellidæ, Ianiridæ, Munnidæ, Desmosomidæ, and Munnopsidæ. In 1905 Hansen accepted the Asellidæ for the genera *Asellus*, Geoffroy, *Mancasellus*, Harzer, and *Cæcidothea*, Packard; he established a new family Stenetriidæ for *Stenetrium*, Haswell, and grouped the other families together under the name Parasellidæ. Without here offering any opinion one way or the other on this grouping, I may observe that as *Jæra*, Leach, is the oldest genus, it may claim to contribute its name to the formation of the family title. In Leach's article "Crustaceology," in the 'Edinburgh Encyclopædia,' vol. vii. 1813–14, at page 434, he gives *Jæra* as twelfth, and *Janira* as thirteenth genus in tribes which we now recognize as Isopods.

As continental writers often appear to consider such forms as *Jæra*, *Iæra*, *Janira*, *Ianira*, *Janthe*, *Ianthe* as respectively equivalents, it may be worth while to note that in each case for English readers the substitution of the second form, beginning with a vowel instead of a consonant, adds a syllable to the name, so that such a form as *Ianthe* is substantially distinct from *Janthe*.

Genus JANIRA, *Leach.*

1813–14. *Janira,* Leach, Edinb. Encycl. vol. vii. p. 434.
1905. *Janira,* Stebbing, in Herdman, Ceylon Pearl Fish., Suppl. Rep. 23, p. 49.
1905. *Ianira,* Hansen, Proc. Zool. Soc. London, 1904, vol. ii. pp. 302, etc.
1905. *Janira,* H. Richardson, Bull. U.S. Nat. Mus. No. 54, pp. 449, 468.

Under the above references the synonymy and characters of this genus will be found fully and instructively discussed. There is, however, one

small point which seems to offer a problem hitherto unconsidered. If the first gnathopods of the male in Hansen's *Stenetrium antillense* and in the new species of *Janira* here described are compared, the illustrative drawings show a remarkable similarity of the distal joints. But these joints, forming in each case the subchela or grasping arrangement, are reckoned as hand and finger in the *Stenetrium*, but as wrist, hand, and finger in the *Janira*. In other words, the dilated joint is preceded by five others in the former case, but by only four in the latter. The result is that in the *Stenetrium* the gnathopod has for its seventh joint a large normally claw-like finger ending in a minute nail, but in the *Janira* the minute nail is supposed to be the finger, and the claw-like joint is regarded as the sixth joint or hand. Now, in the Asellidæ the fifth joint or wrist of the first gnathopod is reduced to very small proportions, and it becomes a question whether in *Janira* the process may have been carried further, and the fifth joint either have been squeezed out altogether or have become undistinguishably coalesced with the sixth joint. While I think this not improbable, it is right to point out that in *Janira minuta*, Richardson, and in *Janira nana*, Stebbing, as well as in *Janira maculosa*, Leach, the supposed finger is not quite so insignificant as in the two species above compared, but has a shape and armature similar to that of the undoubted fingers in the following limbs.

JANIRA CROSSLANDI, sp. n. (Plate **22**, A.)

Though the collection contained three specimens, two males and a female, the uropods were missing from all, nor was a clear view obtained of the frontal outline of the head. The pleon, about as broad as long, has the margins very faintly serrulate.

The slightly prominent eyes are about twice as long as wide, with the inner margin concave.

The first antennæ have the first joint longer than broad, as long as the two following joints combined, the whole peduncle being two-thirds as long as the eight-jointed flagellum, in which the first and third are notably shorter than the joints which respectively follow them. The second antennæ have the first four joints as usual short, with a very small exopod on the third joint, about twice as long as broad, and tipped with two setules ; the fifth and sixth joints are subequal, each a little longer than the first four joints combined ; the flagellum, somewhat longer than the peduncle, was composed of fifty-four very short joints, this and the last two joints of the peduncle being present only on the left side of the smaller male specimen ; so easily detachable is this part, that after examination it was lost in the anxious endeavour to keep it safe.

The mouth-organs appear to agree closely with those figured by Sars for *Janira maculosa*, Leach. The mandibles are contented with four spines in the spine-row. The narrow inner plate of the second maxillæ is tipped with

four small setæ, of which the innermost is the longest. In the maxillipeds the large second joints are united by two pairs of coupling spines.

The first gnathopods were present only in the larger male specimen. Their most characteristic feature is the large fifth joint, of which the homology has been considered above. It is nearly twice as long as broad, with the hind margin produced into a triangular tooth ; near to the hinge of the following joint a second, somewhat similar, tooth projects still further. Over this bidentate palm and considerably overlapping it the narrow so-called hand extends finger-like, rather abruptly crooked at the base and then gently convex on the outer and a little sinuous on the inner margin, the latter more closely setulose than the former ; from the outer end of the shortly truncate apex projects a minute blunt finger or nail, tipped with setules.

The remaining limbs, with slight variations of length, are all nearly alike, having a rather long slender sixth joint, followed by a short finger, with a curved nail at apex of the inner margin and a smaller, movable, curved spine at the apex of the outer margin. Hansen (*loc. cit.* p. 304) regards the outer spine as the nail.

The first pleopods of the male differ a little from those which have been figured for other species, the apices being simple instead of bilobed. The second pair differ from those figured by Sars in having the large outer part more squared below ; whether the little part described by Hansen as exopod was one- or two-jointed could not be discerned ; the masculine appendix or endopod is acutely produced. The respiratory endopod of the third pair probably carries three plumose setæ on the lower margin, as observed on a detached ramus, though absent from those figured.

Length of larger male 2·25 mm., of the smaller 1·75 mm.

Localities. The males taken "25/3/05. Crustacea &c. amg. *M. vulg.* shells," along with *Leptochelia minuta.*

The female specimen, about the same size as the larger male, labelled "04/5.11, Misc. 30.'

The specific name is given in compliment to Mr. Crossland, by whom this and many other interesting species were obtained.

Isopoda terrestria.

Tribe *Oniscidea.*

Family Tylidæ.

1840. "*Tylosiens,*" Milne-Edwards, Hist. Nat. Crustacés, vol. iii. p. 186.
1853. *Tylinæ,* Dana, U.S. Expl. Exp. vol. xiii. pp. 715, 717.
1877. *Tylosinæ,* Miers, Proc. Zool. Soc. London, p. 674.
1885. *Tylides,* Budde-Lund, Isopoda terrestria, p. 272.
1893. *Tylidæ,* Stebbing, Hist. Crustacea, Internat. Sci. Ser. vol. lxxiv. p. 423.

Genus TYLOS, *Audouin.*

1825? *Tylos*, Audouin, Explic. planches Crust. Égypte, p. 287.
1825. *Tylos*, Latreille, Fam. Nat. Règne Animal, p. 567 (*nomen nudum*).
1829. *Tylos*, Latreille, Règne Animal, vol. iv. p. 141.
1831. *Tylos*, Latreille, Cours d'Entomologie, p. 413.
1836–40. *Tylos*, Guérin-Méneville, Iconographie Règne Animal, pl. 31, p. 35
1840. *Tylos*, Milne-Edwards, Hist. Nat. Crustacés, vol. iii. p. 186.
1843. *Tylos*, Krauss, Sudafrik. Crust. p. 63.
1853. *Tylus*, Dana, U.S. Expl. Exp. vol. xiii. p. 715.
1885. *Tylos*, Budde-Lund, Isopoda terrestria, p. 272.
1893. *Tylos*, Stebbing, Hist. Crustacea, p. 423.
1896. *Tylos*, Dollfus, Mém. Soc. Zool. France, vol. ix. p. 550.
1909. *Tylos*, Holmes and Gay, Pr. U.S. Mus. vol. xxxvi. p. 376.

Several other references are procurable by consultation of the above-given list. Guérin dates his plate 31 December, 1836, but in the description, having in the meantime become Guérin-Méneville, he gives a reference to observations made by Milne-Edwards on the respiratory organs of *Tylos* in the "journal l'Institut, n. 280, p. 152, 9 mai, 1839." Notwithstanding the numerous notices and several excellent figures which we have in relation to this remarkable genus, in one or two respects the details of its structure seem still to be rather obscure. All the species seem to be very closely akin one to the other, there being nothing apparently to justify the opinion of Krauss that the two species which he distinguished at the Cape of Good Hope might perhaps require to be placed in a separate genus. There is, indeed, a vast disparity in size between his *T. granulatus*, which is said to reach a length of two inches with a breadth of one inch (50 × 25 mm.), and the *T. albidus*, Budde-Lund, 7·8 mm. by 2·7–3 mm., from the Nicobar Islands, but dimensions of themselves are not sufficient for generic distinction, even apart from the gradations of size furnished by other species in this genus.

As there is only one genus at present recognised in the family, Budde-Lund does not separate their characters. Among these he gives, appendages of the pleon five pairs; first pleopods wanting; appendages of the four following segments having only one ramus apiece, all branchial; ramus of the first segment, however, even in the male, within produced into a long compressed penis; appendages of the sixth segment forming an open column below, with a very small outer ramus at the apex. It will be noticed that here Budde-Lund, after saying "*pedes primi paris desunt*," remarks, "*ramus annuli primi tamen etiam in mare intus in penem longum, compressum productus*," implying that at least in the male the appendages of the first pleon segment are not wanting. In this latter view he agrees with Milne-Edwards, who solved the difficulty of finding only four pairs of pleopods, not by saying that the first pair were wanting, but that the fifth pair were rudimentary. In his Atlas to the 'Règne Animal,' pl. 73 bis,

fig. 2 *d*, he represents the masculine appendix in connexion with a branchial plate, and describes the figure as "L'une des fausses pattes branchiales de la première paire." Von Ebner in 1868, when describing his genus *Helleria*, and comparing it with *Tylos*, made it clear, I think, that the masculine appendix in both genera belonged to the second pleopods, the missing pair being the first. The same author states, I think, correctly that the pleopods here, as elsewhere, are double-branched. As he expresses it, "they carry as well the branchial operculum as the branchial sack." The two, however, are here closely superposed. The uropods are bilaminar, the outer, that is, the ventral opercular leaf, having apically a small semi-oval setiferous branch, regarded as the exopod. Closely applied to the opercular leaf is another, which is distinct from it, at least on the upper and lower borders, reaching about level with it at the narrowed setulose apex, but not reaching its top with its strongly rounded upper border.

The species which I now propose to add to the genus is distinguished not only by its very small size but by its relative narrowness, suggestive rather of the genus *Stenoniscus*, Dollfus, than of *Tylos*. The maxillipeds are six-jointed, having the palp, therefore, three-jointed instead of two-jointed, as given by Budde-Lund in the family character. Young ones, of the same length, of *Tylos latreillii*, Audouin, brought to me from Formiae by the late E. Mello Saunders, Esq., are globose, half as broad as long, and in two of them that were dissected no trace appeared of the male appendix. The solitary specimen in Mr. Crossland's collection accordingly seems to represent a new species, in proximity to *T. albidus*, Budde-Lund.

Tylos exiguus, sp. n. (Plate **23**.)

The small size of the specimen leaves it open to the suspicion that it may be the young of some species already known. Against this explanation may be set the development of the second pleopods with male characteristics, and the general shape, which is not a full oval as usual in the genus, but of such narrowness as to make perfect globation not very feasible. As will be seen from the figures, the other details agree closely with the corresponding parts of *T. latreillii*.

It belongs to the group of species in which the scutellum, surmounting the epistome, is conspicuously triangular, not as in *T. granulatus*, Krauss, quadrate with rounded upper margin. In the last-mentioned species the triangular apex is bent so as to be quite inconspicuous.

The second antennæ have the fifth joint of the peduncle scarcely as long as the flagellum, of which the first two joints are equal in length, each considerably longer than the tapering third joint. In *T. albidus* the third joint is described as the longest.

The mandibles show five or six plumose setæ, two separate groups between the cutting-edges and the molar, and a large one by itself on the further side

of the molar. The three joints of the maxilliped palps have been already mentioned. Their boundary-lines are rather faint.

The ventral plates of the fifth pleon segment are of moderate size, slightly curved, with the free end truncate.

The colour of the preserved specimen pallid, with black dots not thickly strewn.

Length 4·5 mm., breadth scarcely 1·5 mm.

Locality. Red Sea, 1904–5. Misc. 68.

An imperfect specimen of one of the more ordinary forms of Oniscidea and some Talitridæ occurred in the same glass tube with this *Tylos*.

EXPLANATION OF THE PLATES.

PLATE 21.

Lanocira latifrons, sp. n.

n.s. ♂. Natural size of the male specimen represented in the adjacent figure.

n.s. ♀. Natural size of the female specimen, of which the head only is shown.

C. ♂, C. ♀. Dorsal view of head, respectively of the male and female.

a.s., *a.i.*, *a.i.* First and second antennæ, with the abnormal apex of one of the lower pair further magnified.

l.s., *m.*, *mx.* 1, *mxp.* Upper lip, a mandible (probably not quite perfect), one of the first maxillæ in two opposite aspects, the maxillipeds.

gn. 1, *gn.* 2, *prp.* 5. First and second gnathopods, and fifth peræopod.

plp. 2. Second pleopod, with further enlargement of the masculine appendix.

Pl. Dorsal view of the pleon, with the uropods.

The mouth-organs, the gnathopods, the fifth peræopods, and the two further enlargements are on a uniform scale, higher than that of the other details.

PLATE 22 (A).

Janira crosslandi, sp. n.

n.s. Line indicating natural size of the male specimen figured below, head, peræon, and pleon, separated; the upper lip protrudes in front of the head, of which the frontal line could not be clearly ascertained. The limbs of the slightly flattened peræon are shown on the right side, and the distal part of the first gnathopod and seventh joint of the second peræopod are further magnified.

oc. One of the eyes.

a.s., *a.i.* First antenna and proximal joints of second antenna.

l.s., *l.i.* Upper and lower lips.

m., *mx.* 1, *mx.* 2, *mxp.* Mandible, first and second maxillæ, and maxillipeds.

plp. 1, 2, 3. First, second, and third pleopods of male.

The eye, basal joints of second antenna, first maxilla, and third pleopod are separately drawn from the specimen figured under *n.s.*; the other mouth-organs and pleopods and the first antenna from another, smaller, male specimen.

Plate 22 (B).

Exosphæroma reticulatum, sp. n.

n.s., *n.s.* ♂. Line to the left indicating natural size of specimen represented in dorsal view; line to the right indicating natural size of a male specimen from which the details were figured.

Pl. ♂. Pleon and uropods of male.

a.s., *a.i.* First and second antennæ.

l.s., *l.i.*, *m.*, *m.*, *mx.* 1, *mx.* 2, *mxp.* Upper and lower lips, mandibles, first and second maxillæ, and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and last five joints of fifth peræopod.

plps. The first and second pleopods seen from the underside, along with the genital papillæ of the seventh peræon segment. On the left the first pleopods are indicated without setæ, and the second pair are detached.

All the details, except the pleon and uropods, are drawn to a uniform scale.

Plate 23.

Tylos exiguus, sp. n.

n.s. Lines indicating natural size of specimen figured below.

Pl. Dorsal view of pleon.

v.l. Ventral lamina of fifth pleon segment.

a.i. Second antenna.

l.s. Upper lip, with epistome and scutellum.

m., *m.* The mandibles.

l.i. Lower lip.

g. The stomach.

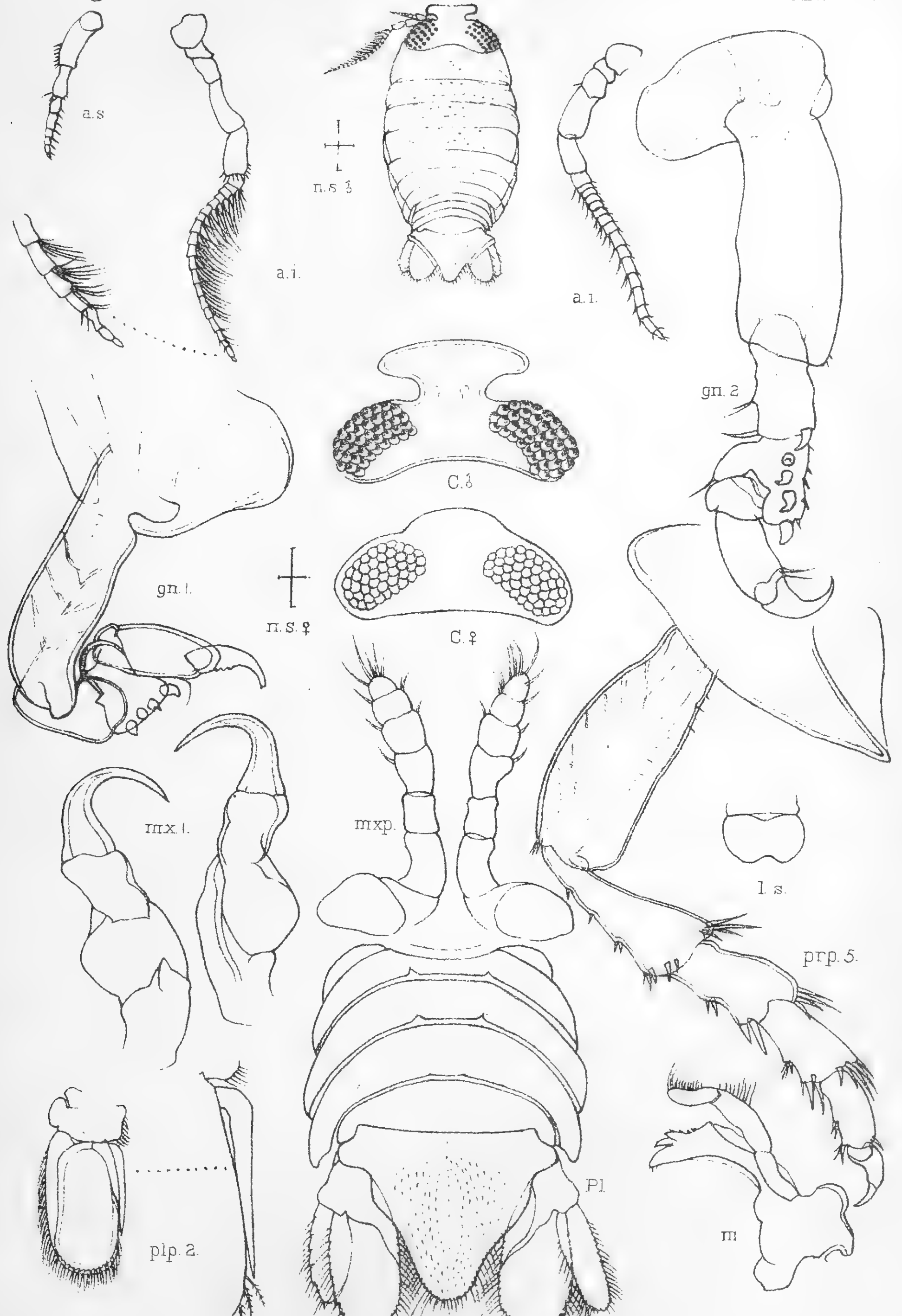
mx. 1, *mx.* 2, *mxp.* First and second maxillæ and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peræopod.

plp. Second pleopod.

urp., *urp.* The uropods, one on the right from the ventral side, that on the left from the upper side.

JOURN. LINN. SOC. ZOOL. Vol.XXXI. Pl.21.

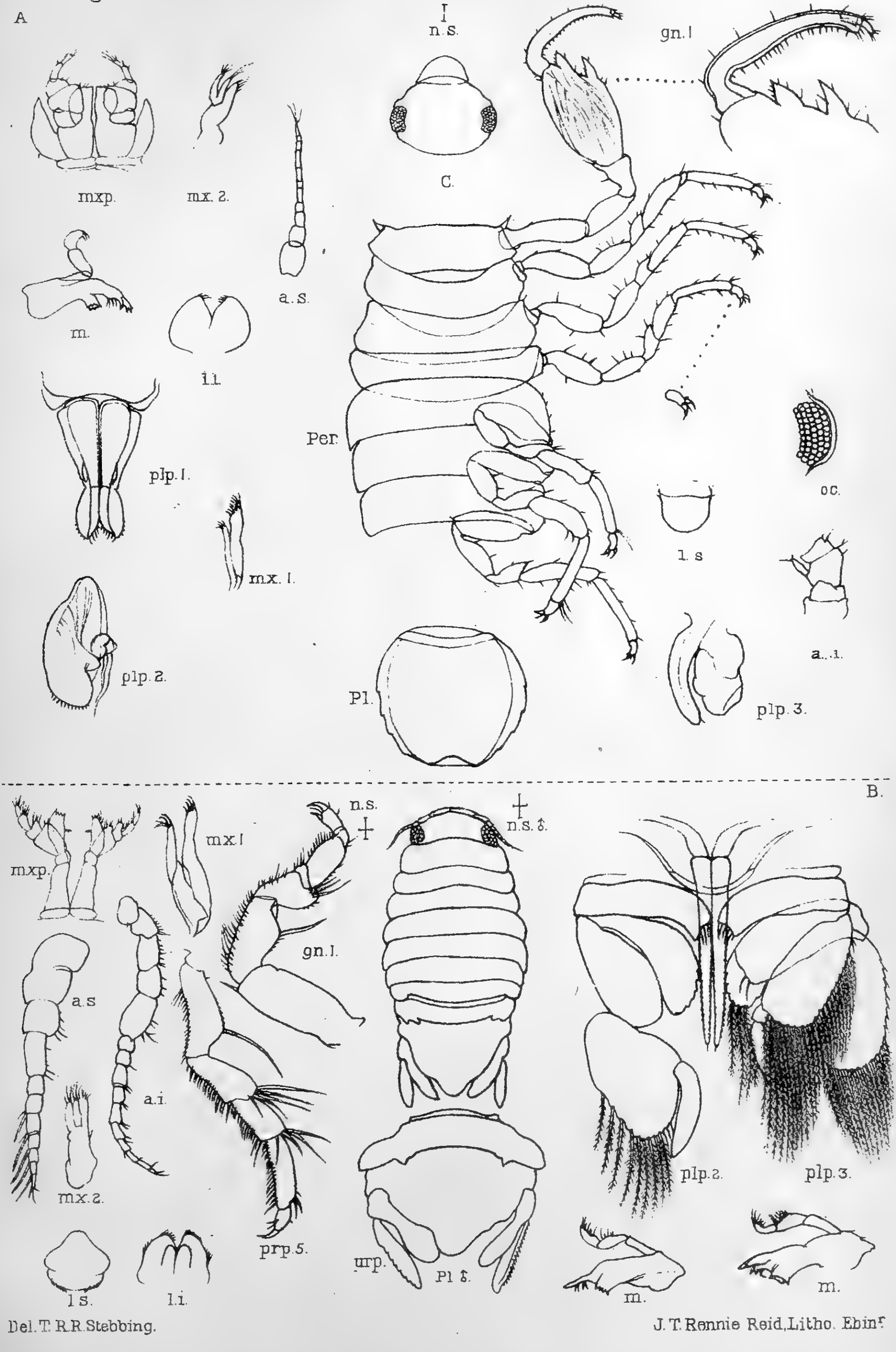


Del. T.R.R. Stebbing.

J.T. Rennie Reid, Litho. Edin^r.

LANOCIRA LATIFRONS, n. sp.

Journ. Linn. Soc. Zool. Vol. XXXI. Pl. 22.



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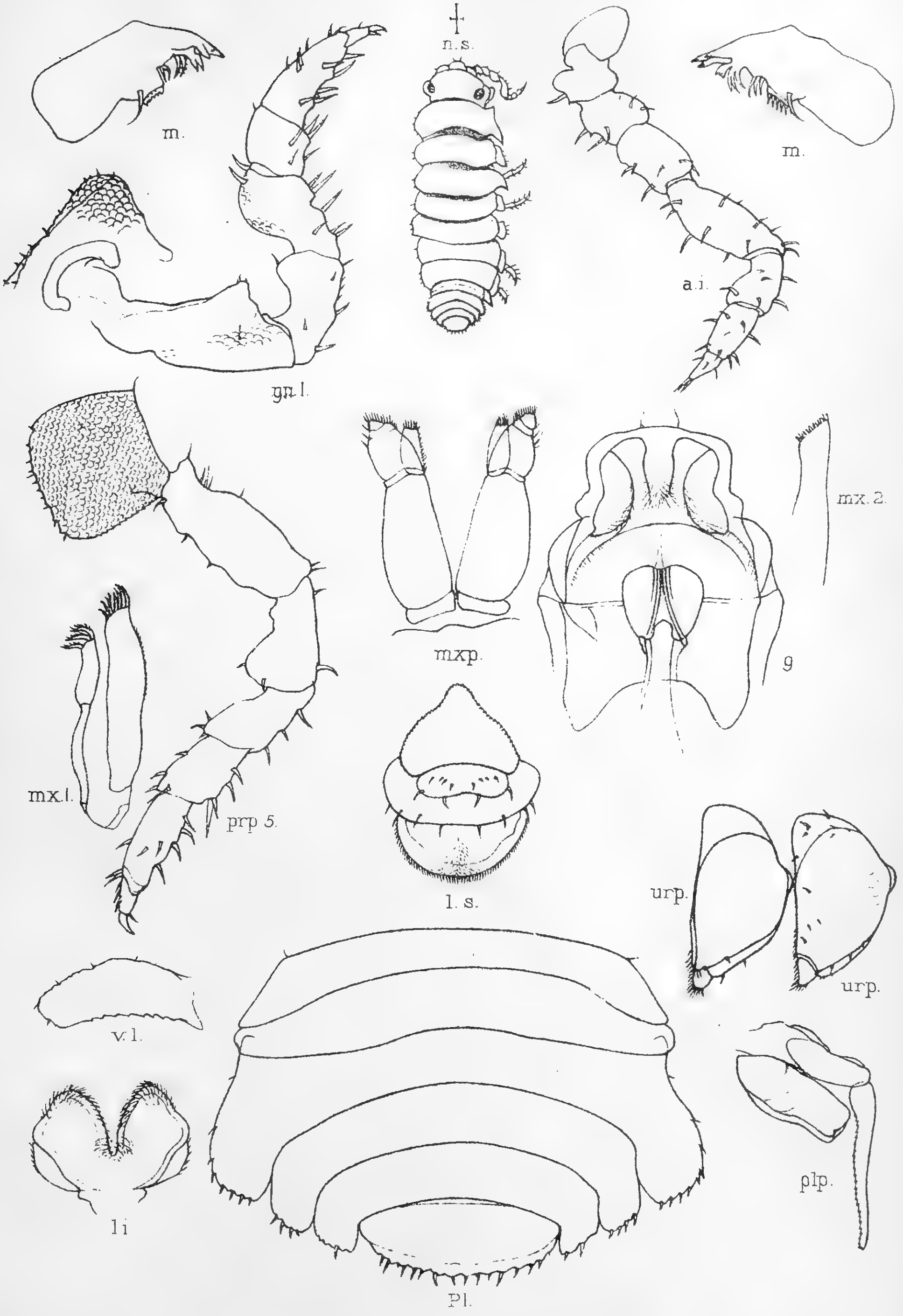
A. JANIRA CROSSLANDI, n. sp. B. EXOSPHAEROMA RETICULATUM, n. sp.



Del. T. R. R. Stebbing. J. T. Rennie Reid, Litho. Edin[r]

TYLOS EXIGUUS, n. sp.

Reports on the Marine Biology of the Sudanese Red Sea, from Collections made by Cyril Crossland, M.A., B.Sc., F.Z.S.; together with Collections made in the Red Sea by Dr. R. Hartmeyer.—XV. The Bryozoa. By Arthur Wm. Waters, F.L.S.

Part II.

CYCLOSTOMATA, CTENOSTOMATA, and ENDOPROCTA.

(Plates 24 & 25.)

[Read 16th December, 1909.]

These collections of the Red Sea Cyclostomata, Ctenostomata, and Endoprocta, representing but few species, have been studied together with the other collections made by Mr. Crossland from Zanzibar and Cape Verde Islands, and when the description of these is reached I hope to be able to add some details.

When considering the Ctenostomata I indicate the direction in which it seems that we must work in order to make the classification more satisfactory, and show that the Stolonifera of Ehlers contains: firstly, some species having usually a thick stem to which the zoœcia are directly connected as in *Zoobotryon*; and, secondly, others with a creeping filamentous tube or rhizome, which expands in places, and from these swollen nodes the zoœcia grow, in most cases from a joint attached to the expansion. It is now proposed to limit the Stolonifera to these last, of which *Hypophorella* and *Farella* may be taken as typical; and then the first group remain as Vesicularina. In Vesicularina a gizzard seems to be universal, but is not found in the other group. Details concerning the gizzards are given in the paper. Unfortunately I do not possess satisfactory specimens of several of the Ctenostomata, and therefore only locate some of the genera tentatively, but hope shortly to obtain specimens of other genera from which to cut sections. It will be noticed that nearly all the Cyclostomata and Ctenostomata from the Red Sea are also known from the Mediterranean. In this and the previous paper 99 Red Sea species and varieties are referred to; of these, 34 are known from the Atlantic, 26 from British Seas, 39 from the Mediterranean, 34 from Indian and neighbouring seas, 18 from Crossland's Zanzibar collection, 8 from Japan, and 36 from Australia.

Since my previous paper was written *Membranipora limosa*, Waters, has been recognized by Levinsen from Formosa Channel.

Table of Distribution from West to East, as in Part I., pages 126–128, *of this volume.*

Page.		Cape Verde Is.	Atlantic.	British.	Mediterranean.	Red Sea.	Indian Ocean.	Ceylon.	Zanzibar.	Japan.	Australasian.	Fossil.
	Cyclostomata.											
232	*Crisia denticulata*, Lamk. ..	+	+	+	+	+	..	..	..	..	+	
234	,, *producta*, Smitt	..	..	+	+	+						
234	,, *ramosa*, Harmer	..	..	+	+	+						
235	,, *cylindrica*, Busk	..	..	..	..	+						
235	*Filisparsa tubulosa*, Busk ..	..	+	..	+	+	..	..	..	..	+	+
237	*Lichenopora radiata*, Aud. ..	..	+	+	+	+	..	..	..	+	..	+
	Ctenostomata.											
243	*Amathia tortuosa*, T.-Woods .	..	..	..	..	+	..	..	..	..	+	
243	*Zoobotryon pellucidum*, Ehr...	+	+	..	+	+	..	..	+	..	+	
248	*Bowerbankia imbricata*, Adams	..	..	+	+	+						
250	*Valkeria uva*, L.	..	..	+	+	+	..	+	+			
251	*Cylindrœcium dilatatum*, H. .	..	..	+	+	+	+	+				
251	,, *giganteum*, B. .	..	..	+	+	..	..	+				
	Endoprocta.											
251	*Barentsia gracilis*, Sars	..	+	+	+	+	..	..	..	..	+	
252	*Loxosoma Kefersteinii*, Clap. .	..	..	..	+	+						
	Addenda.											
253	*Aetea Crosslandi*, sp. nov. ..	..	..	..	..	+						
254	*Retopora abyssinica*, var. *expansa*, nov.	..	..	..	..	+						

CYCLOSTOMATA.

Crisia denticulata (*Lamarck*). (Plate **24**. figs. 1–3 ; Plate **25**. fig. 11.)

Cellaria denticulata, Lamk. Anim. sans Vert. vol. ii. p. 137.

Crisia denticulata, M.-Ed. Ann. Sc. Nat. ser. 2, vol. ix. p. 201 (9), pl. 7. fig. 1; Harmer, "Brit. Spec. of *Crisia*," Micr. Journ. vol. xxxii. n. s. p. 129, pl. 12. figs. 1–3 (1891). For other synonyms, consult Miss Jelly's Catalogue.

As Harmer has shown, we cannot in a large number of cases be sure as to authors' determination of *C. denticulata*, and Busk had more than one species before him when preparing his catalogue. There is, however, no doubt that

it occurs in the British and neighbouring seas, the Mediterranean and the Red Sea, and Australia, and though certainly elsewhere also, we must wait until more comparative studies of the ovicell have been made before we can be certain as to the distribution. There is below the aperture a small thin oval spot (fig. 11), clear in balsam preparations, which occurs in all specimens examined from various localities, but does not seem to have been mentioned, though a mark somewhat lateral is shown by Hincks. I do not find this mark in any other species nor in *Crisia denticulata*, var. *gracilis*, Busk, which, however, I should not place with *denticulata*.

The ovicell is lateral, short, and pomiform, as I would call such ovicells, in opposition to the pyriform ovicells. In two or three cases there is a narrow tube from the distal base of the ovicell.

The distance from zoœcium to zoœcium is about 0·28 mm. Without the ovicells the determination of *Crisia* is most difficult and often with small pieces impossible.

However, another character of great importance is the distance apart of the zoœcia, and if mature portions are taken and not the extremities it will be found that most correspond very nearly to type measurements. For such measurements I set the threads of a micrometer over a typical portion and then bring a number of others under the micrometer. Harmer has shown that the position of the *basis rami* may be of use in some species, but the number of cases in which it will be of use is somewhat restricted. The position depends to a large extent upon the width of the opening for the joint, and it is worth attention that the size of the main and lateral joints seems in all cases to be the same, and when they are very large then the opening is directed laterally and is usually about halfway between the two zoœcia. The size of the aperture of the zoœcia is certainly a character of primary importance and there is but very slight variation through a colony. The mode of branching is often a character of considerable value. The position of the joint has been stated in two ways, either counting all the zoœcia of an internode below the new branch, or only the zoœcia on the one side, as, for example, the fifth zoœcium of an internode is the third on the side from which the new branch commences. Harmer in his important paper on *Crisia* speaks of the number on the one side, and I shall therefore follow him, though perhaps it would have been better to give the total number of zoœcia before the commencement of a branch.

In the *C. tubulosa* group the zoœcia are far apart (about 0·5–0·6 mm.), the aperture of the zoœcia is large (about 0·1 mm.), the ovicell is central, pyriform, and long. In *C. ramosa*, Harm., the distance is about 0·4 mm. apart, with the aperture about 0·07 mm. In the *C. denticulata* group the distance is about 0·3 mm., the aperture about 0·06 mm., the ovicells are shorter and more to one side than in the truly pyriform ovicells.

We are acquainted with radicles in various positions, but one from Khor

Dongola having them from each terminal zoœcium has been thought worthy of a figure (Pl. **24**. fig. 3).

In the Sudan specimens I have seen a few short tubules to the closures and have not seen them in any other *Crisia*.

Loc. British, French, and neighbouring seas, Cape Verde Is. (*Cross. Coll.*), Mediterranean, Cape York, Australia (*Chall.*), Khor Dongola (19*) ; Engineer Island, Khor Dongola, collected by Crossland ; Ras el Millan, collected by Hartmeyer.

Crisia producta, *Smitt.*

Crisia producta, Smitt, Öfv. K. Vet. Förhandl. p. 116, pl. 16. figs. 4–6 (1865).

See Miss Jelly's Catalogue under *C. eburnea*, var. *producta*, and add :—*Crisea eburnea*, var. *producta*, Levinsen, "Mosdyr," Zool. Danica, vol. iv. (1894) p. 74, pl. 6. fig. 40.

There are a few small specimens which fairly agree in size of the zoœcial aperture (0·06 mm.) with *C. cornuta* and *C. geniculata*, and I certainly see no reason for placing it near *C. eburnea*, in which the growth of the new zoœcium forming a fresh branch is very different. The growth of the Mediterranean *C. fistulosa*, Heller, is similar, but the zoœcia in that species are much stouter, with wider apertures (0·1–0·11 mm.), the joints are larger and the internodes are longer, so that they are easily distinguishable. However, we may imagine, from *C. geniculata*, placed under favourable circumstances, the form *producta* arising and then growing into the stouter *C. fistulosa*. *C. geniculata* occurs near Naples.

Loc. Arctic, British, Danish, Naples, Suez, Sudan (18*), collected by Crossland.

Crisia ramosa, *Harmer.*

Crisia ramosa, Harmer, "Brit. Spec. of *Crisia*," Micr. Journ. vol. xxxii. n. s. p. 134, pl. 12. figs. 10, 11.

There are from the Sudan a few small pieces, which appear much more delicate than most parts of *C. ramosa*, the zoarium being only about 0·1 mm. wide, but on comparing with one of the lower branches of a good specimen of *ramosa* I found the similarity very close. Although the ovicell of the Sudan specimen is a trifle the smaller the shape is the same, and although the œciostome is somewhat broken there evidently was a funnel. The distance from aperture to aperture is about 0·4 mm. and the zoœcial aperture is about 0·06 mm. The branches arise, as in the British specimens, usually after the first zoœcium on the one side. In specimens from Naples corresponding in the size of the zoœcia and the distance apart, the zoœcia usually arise after the second zoœcia, though I have seen some after the first ; the ovicells and the funnel are quite similar to the British form, as is also the frequency of

* These and similar numbers are Crossland's registration numbers.

branching, but the zoœcia in the branches are usually more numerous. The basis rami are placed high up as in the British form. This Mediterranean form is what I called *Crisia elongata* var. *angustata* *, though it does not seem that the specimen described and figured was a very characteristic one. It seems as though a modification of the position of the branches had taken place in the Mediterranean, but whether varietal or specific separation is justified can only be decided by the examination of considerable quantities from various localities. In my description of *C. elongata* var. *angustata* by a printer's error the distance from zoœcium to zoœcium is given as 0·04 instead of 0·4 mm.

Loc. Plymouth (*Harm.*), Naples (*A. W. W. coll.*, the form referred to). From among the Lamellibranchs which cover the rock at Suez (18), collected by Crossland.

CRISIA CYLINDRICA, *Busk*. (Plate **25**. figs. 14, 15.)

Crisia cylindrica, Busk, Zool. 'Chall.' Exp. vol. xvii. (1886) pt. L. p. 7, pl. 2. figs. 2–4.

On *Canda arachnoides*, Lamx., from Gimsah Bay there is a small colony, which seems to be *C. cylindrica*. At the base there is a blind internode and the zoarium is at first very narrow ; after the second zoœcium branching takes place followed by a branch on the other side after the fourth zoœcium.

The zoœcia are about 0·28 mm. distant and the zoœcial aperture is about 0·05 mm. The ovicell is shortly pyriform with a tubular oœciostome with the opening about 0·05 mm. wide. The pores on the zoœcia are very large. Busk does not figure the ovicells, though he refers to them ; but in the British Museum collection of the 'Challenger' specimens I have not found any, however in these the zoœcia are about 0·35 mm. apart. In the 'Challenger' mount a new branch arises from the end of the zoœcial tube, as figured in the 'Challenger' Report, pl. ii. fig. 2 *a*, but as it is not alluded to by Busk it seems advisable to call attention to the unusual growth, which might possibly be passed over as an artist's mistake.

Loc. Nightingale Island, 100–150 fath. ('Chall.') ; Gimsah Bay, collected by Hartmeyer.

FILISPARSA TUBULOSA, *Busk*. (Plate **25**. figs. 16, 17.)

Hornera violacea, var. *β. tubulosa*, Busk, Cat. of Mar. Polyzoa, p. 19, pl. 18. fig. 4 (1875).

Filisparsa sp., Manzoni, "Bry. du Plioc. de Rhodes," Mém. Soc. Géol. de France, 3e sér. vol. i. (1877) pt. ii. p. 69, pl. 3. fig. 18, *a* & *b*.

Filisparsa tubulosa, Waters, Ann. Mag. Nat. Hist. ser. 5, vol. iii. (1879) p. 275; id. vol. xx. (1887) p. 257.

* "Bry. of the Bay of Naples," Ann. Mag. Nat. Hist. ser. 5, vol. iii. (1879) p. 269, pl. 23. fig. 4.

Filisparsa Delvauxi, Pergens, "Plioc. Bry. de Rhodes," Ann. Nat. Hist. Hofmus. Wien, vol. ii. (1887) p. 6; Bull. Soc. Belge de Géol. vol. iii. (1889) p. 64; Bull. Soc. Roy. Malac. de Belge, p. (2) & p. (6) (1889).

? *Idmonea gasparensis*, MacG. Trans. Roy. Soc. Vict. vol. xxiii. p. 185, pl. 2. fig. 3.

The specimen from Ras el Millan is only small and is partly covered by an encrusting foraminifer, but it shows the formation of the ovicell on the anterior surface very well. The end of the branch is clavate, and here the wall to cover the cell has just commenced to form, so that zoœcia passing through the ovicell become funnel-shaped at the end—that is to say, from each zoœcium the finely perforated ovicell wall is commencing to grow, and will join the wall growing up from the base. It will be seen from the figure that there are a large number of zoœcia in the ovicell. On the dorsal surface, near the ovicell, two or three zoœcia are seen, at first suggesting *Entalophora.*

The apertures of the zoœcia are about 0·13 mm.

Filisparsa, as illustrated by d'Orbigny, may include forms belonging to more than one genus; but *F. neocomiensis*, d'Orb., may be taken as the type, with *F. crassa* doubtful. I* have previously alluded to the fact that the ovicell of *Filisparsa* is anterior, whereas in *Idmonea irregularis*, Meneghini, the ovicell is dorsal. Perhaps the genus *Tervia* may be retained for that group, as *Tervia folina*, Jull., is the *Idmonea irregularis,* Meneg. However, we stand on very uncertain ground regarding these genera until the ovicells of more species are definitely known. The dorsal position of the ovicell, which in this respect resembles *Hornera*, seems sufficient to remove such species from *Idmonea*, but of this we are not quite certain. From Zanzibar I have specimens in most respects like *Idmonea irregularis*, with the ovicell anterior spreading for a considerable length among the zoœcia, with the oœciostome curved over like the indraught funnel of a steamer. In considering the value of the position of the ovicell, we must not forget the extraordinary ovicells of *Idmonea Meneghini*, Heller †, in which they take the place of one complete lateral series, showing what different forms the ovicells may take.

Loc. Naples (*W.*); North Atlantic (*B.*); Holborn Island, Queensland, 20 fath. (*W.*); Victoria ?; Ras el Millan, collected by Hartmeyer.

Fossil. Rhodes; Wola Lu'zanska (Eoc.). Mamàh (Tert.).

* Quart. Journ. Geol. Soc. vol. xl. (1884) p. 687.

† Waters, "Ovicells of Cyclostomatous Bryozoa," Journ. Linn. Soc., Zool. vol. xx. (1888) p. 278, pl. 14. fig. 2.

Lichenopora radiata (*Audouin*).

For synonyms, see Miss Jelly's Catalogue, and add:—

? *Diastopora catillus*, Johnson, "Cyclos. Bry. found at Madeira," Ann. Mag. Nat. Hist. ser. 6, vol. xx. (1897) p. 61.

Lichenopora radiata, Neviani, "Bri. neog. delle Calabrie," Pal. Ital. vol. vi. (1900) p. 246; Bri. foss. della Farnesina & Monte Mario, presso Roma," Pal. It. vol. i. (1895) p. 135; Calvet, "Bry. mar des Côtes de Corse," Trav. de l'Inst. de Zool. de Montpellier, sér. 2, Mém. 12, p. 44 (1902); Ortmann, A., "Die Japan. Bry.," Arch. für Naturgesch. vol. i. (1890) p. 64; Jullien & Calvet, 'Bry. provenant des Campagnes de l'Hirondelle,' p. 119 (1903); Norman, "Polyzoa of Madeira," Journ. Linn. Soc., Zool. vol. xxx. (1909) p. 281.

There are a few specimens from among the lamellibranchs which cover the dock walls at Suez. *L. radiata* has 9 tentacles. I can only give *Diastopora catillus* as a synonym on Norman's authority, as the description does not at all correspond.

Loc. British; Mediterranean; Bay of Biscay, 135 met. (*J. & C.*); Madeira (*Norm.*); Japan (*Ort.*); Samoa, mentioned by Ortmann; Suez (18), collected by Crossland.

Fossil. Farnesina (Postpliocene); Pliocene and Postpliocene of Calabria and Sicily.

CTENOSTOMATA.

The examination of the Ctenostomata from Mr. Crossland's collections has left me dissatisfied with our knowledge of this group; although the characters used are mostly zoarial, the way in which the zoarium grows and spreads, which is undoubtedly a character of considerable importance, has in most cases been insufficiently described.

The group is based upon the so-called setose collar; but this is an unsatisfactory name, for though there may often be an appearance of spines or hairs projecting from the aperture, further examination with sufficient magnification shows that this is not the case, and that there is only a cylindrical prolongation which is thrown into folds with thicker ridges. This collar has been correctly described by Ehrenberg, Ehlers, and others; and Jullien has shown that to speak of it as setose has been misleading. However, it has even been described as having bristles round the aperture. This collar may be seen projecting from the aperture of a zoœcium in which all the organs have disappeared, and this makes it difficult to follow Ehlers in considering that it represents the diaphragm or sphincter which closes the tentacular sheath of the Cheilostomata.

(1) First, there is a group forming a fleshy or chitinous expansion, either adnate or erect, in which the zoœcia are developed directly from other

zoœcia. There is no gizzard, there are a considerable number of tentacles; some are oviparous and produce Cyphonautes.

The genera included are *Alcyonidium*, *Flustrella*, *Pherusa*, *Clavopora*, and *Lobiancopora*. This group has been recognised as Alcyonellea, but has also received other names. The remainder have been grouped together as Stolonifera, Ehlers, but it seems to me that two quite distinct things have been called stolons. The genus *Hypophorella* of Ehlers, which is really the type of the Stolonifera, has a creeping or erect tubular filamentous stolon or rhizome—that is, a very slender and delicate tube expanding at intervals for the production of zoœcia, as in *Hypophorella*, *Farella*, *Triticella*, *Valkeria*, *Mimosella*; so that the term rhizome used by Foettinger and Potts in describing *Pedicellina* seems very appropriate, as the growth is usually similar to the rhizome of plants.

(2) Next we have a group with a free thick stem from which the zoœcia grow direct from various parts, as in *Zoobotryon*, *Amathia*, &c., and none seem to grow from a thin segmented creeping filament, though in *Amathia* * the stem at first spreads out on the supporting surface; and then in places on the stem a watch-glass hollow is formed from which the subcolonies arise. In all the genera with these uniform thick free stems there is a gizzard, and the number of tentacles is usually small (8–10). The genera included are *Zoobotryon*, with its synonym or ally *Bowerbankia*; *Amathia*; *Vesicularia*; and *Buskia socialis* †, Hincks; *Avenella* (?), Dalzell; *Cryptopolyzoon*, Dendy. It will be best to restrict the name Vesicularina to this group, although both Ehlers and Hincks put the various species under the Stolonifera.

(3) Lastly, the Stolonifera as now limited have, as a rule, no gizzard, but Joyeux-Laffuie mentions one as a generic character in *Hypophorella*, though without further particulars; however, as nothing of the kind is mentioned or figured by Ehlers, I take it that there is no gizzard in *Hypophorella*, though until sections have been made there will be some uncertainty. Some text-books have, however, incorrectly given the gizzard as a character of the whole Ctenostomata. Hincks mentions a gizzard in *Avenella*, in which the number of tentacles is given as 20–24. It is clear that search should always be made for the gizzard, although we do not at present know what the classificatory value may be.

As stated, in *Hypophorella*, *Farella*, *Valkeria*, *Triticella*, there is a delicate rhizome which expands at intervals, and from this expansion one or a pair of zoœcia grow, and also one or two fresh creeping filaments or radicles at right angles to the parent tube; or from the expansion a nodular attached growth may take place on each side, and from each nodule a fresh pair may grow forming groups of zoœcia as in *Valkeria*. Throughout the group there is a

* A short radicle attachment is thrown out here and there for attachment.

† See p. 241.

tendency to grow in pairs (Pl. **24**. fig. 14, &c.). The creeping stolon has a septum immediately following the expansion just mentioned; and in *Farella repens*, Farre, and *Valkeria uva*, L., there are muscles across the expansion as figured by Ehlers in *Hypophorella expansa* *, Ehl., but these points have been overlooked in both species †.

We may hope that the zoœcia will give us some useful characters, but so far but few have been found. I would, however, point out two that should be looked for. The zoœcium (after the tentacles, other organs, and muscles have disappeared) often has quite a different form from the ordinary zoœcia; then, as Farre ‡ has mentioned, the position of the parietal muscles should be examined. These muscles may be single, or in groups of two, four, or even more, and probably the different shape of the empty zoœcial chambers is caused by the disappearance of these muscles. The empty zoœcial chambers are well figured by Ellis (Nat. Hist. Corallines, pl. xv. fig. C). I also think that the appearance called in some species by the unfortunate name "area" depends upon contractions formed by these muscles—at any rate, in spirit specimens I have been unable to find any difference in the structure of the different parts of the zoœcial wall in any genus examined.

In making the group Stolonifera, Ehlers showed how various Bryozoa grow from creeping stolons, and that they occur in *Crisia*, *Chlidonia*, *Pedicellina*, &c. Since Ehlers wrote there have been many changes of opinion, and it would hardly serve any purpose to criticize all the conclusions he came to at that time, though we may say distinctly that a somewhat similar growth, from filaments, may take place in most widely separated genera. In *Crisia* creeping stolons are formed, and from these at intervals subcolonies arise, and, further, sometimes from the ordinary radicles a fresh zoœcial growth may start; but from what I have seen this growth takes the same form as an older internode, whereas the first and subsequent subcolonies growing from the stolon in *Stirparia*, *Gemellaria*, and various other Cheilostomata consist at the base of one zoœcium from which the others grow, though maintaining a slender growth for some distance before the branches attain their ordinary size, for in these cases the first zoœcium of each subcolony has the form of a primary zoœcium. There is also a rhizome in *Alysidium Lafontii*, Aud., and *Micropora ratoniensis*, Waters, and in this last subcolonies grow from the rhizome. In *Aetea*, *Beania mirabilis*, Johnst., and *Hippothoa* the creeping portion is connected directly with the rest of the zoœcium, forming one chamber, and this cannot be compared with the rhizome of the Stolonifera.

Busk made a group Stolonata for forms growing on a stalk, most of which

* Abhand. d. Gesellsch. d. Wissenschaft Göttingen, vol. xxi. (1876) pl. i. figs. 3, 6.

† In the pinnæ of *Mimosella gracilis*, Hincks, there are similar muscles below the septum. There is usually a septum below each pair of zoœcia, but sometimes this is absent, and then there are no muscles.

‡ Phil. Trans. (1837) p. 396, Pt. I. pl. 21. fig. 13, pl. 24. fig. 3, no. 3, figs. 4, 5.

give off numerous radicles, but a consideration of his list, in the 'Challenger' Report, suggests that they are not closely allied.

The larva of but few genera is known, but Prouho shows that *Hypophorella* lays an egg, and has a larva with the characters of Cyphonautes, though whether it has a "shell" is not conclusively shown. Several of the Ctenostomata discharge an unsegmented egg, either through an intertentacular organ (*Alcyonidium duplex*, Prouho; *A. albidum*, Ald.) or through a simple opening by the base of the tentacles (as in *Hypophorella*, Ehlers; *Farella repens*, Farre), but in the majority the larva develops in the tentacular sheath. This naturally requires much space, and the polypide usually dies down as the larva develops. In the Cheilostomata, when there is an ordinary ovicell, whether external or internal (as in *Lepralia cucullata*, &c.), there is no necessity for the disappearance of the polypide, and we find long rows of polypides in perfect activity, with ova developing and larvæ in the ovicells. Exact observations on the development have been made on but few Ctenostomata. It is very likely that a comparative study of the primary zoœcia of the Ctenostomata may give us valuable assistance.

Pending further examination the Ctenostomata may be provisionally tabulated as

Alcyonellea.

Usually many tentacles; no gizzard; larva in some species with intestine, and sometimes Cyphonautes.

Alcyonidium, Lamx. 15–27 tentacles; no gizzard.

Flustrella, Gray. 19–27 tentacles (*Waters*), 30–35 (*Hincks*); no gizzard.

Pherusa, Lamx. 15 tentacles (*Waters*); no gizzard.

Lobiancopora, Pergens *. 24 tentacles; no gizzard. Probably belongs here.

? *Clavopora*, Busk, 1874. Apparently belongs to this division. It has been subsequently described as *Aschoriza*, Fewkes (16–18 tentacles) (*Robertson*).

Vesicularina.

Usually 8–10 tentacles; a gizzard; the zoœcia grow direct from the stem and have no independent movement.

Zoobotryon, Ehr. 8 tentacles; a gizzard.

Bowerbankia, Farre. 8–10 tentacles; a gizzard. Apparently a synonym of *Zoobotryon*.

Amathia, Lamx. 8–10 tentacles; a gizzard.

Vesicularia, Thomps. 8 tentacles; a gizzard.

? *Avenella*, Dalzell. 20–24 tentacles; a gizzard (*Hincks*).

* Sections show that *Lobiancopora hyalina*, Pergens, has an intertentacular organ.

Buskia socialis, Hincks. 8 tentacles ; a gizzard (*Waters*), This must be put in another genus, as it differs widely from *B. nitens*, Alder, and *B. setigera*, H. The zooecia are attached direct to the thick stem, whereas in *B. setigera* there is a rhizome.

Cryptopolyzoon, Dendy. 10–14 tentacles ; a gizzard with two grindstone teeth, entirely different to the gizzards of other genera.

Stolonifera.

There is a delicate creeping rhizome, which at intervals expands, and from these expansions the zooecia arise usually in pairs ; no gizzard.

Hypophorella, Ehlers. 10–11 tentacles. Joyeux-Laffuie mentions as a character a gizzard, but does not refer further to it, and from Ehlers's fuller description it certainly does not seem that there is a gizzard.

Farella, Ehrenberg. 11–12 tentacles; no gizzard.

Valkeria, Flem. 8 tentacles; no gizzard.

Mimosella, Hincks. 8 tentacles ; no gizzard.

Triticella, Dalzell *. 18–20 tentacles ; no gizzard (*Hincks*).

Cylindrœcium, Hincks. 10–20 tentacles ; no gizzard.

Buskia setigera, Hincks. No gizzard.

The following cannot at present be placed :—*Anguinella*, V. Ben. ; 10 tentacles, no gizzard (*H.*). *Arachnidium*, Hincks., is not this allied to *Cylindrœcium* ? *Victorella*, Saville Kent, 12–14 tentacles. S. Kent said no gizzard, but Bousfield and Kraepelin state that they found one, though as the description hardly corresponds with the gizzard of other species sections are desirable. Loppens † has recently stated that there is no gizzard. Perhaps this should be put in a separate group with *Paludicella*. *Arachnoidea*, Moore, looks like *Arachnidium*. *Monastesia*, Jullien, is perhaps *Buskia*. *Hislopia*, Carter, is said by Carter ‡, Jullien §, and Annandale || to have 16 (?) tentacles, and a gizzard, which from the description is somewhat like that of *Cryptopolyzoon*, but further details are required. It is an encrusting species. *Norodonia*, Jullien : Annandale considers that this is *Hislopia*.

* *Hippuraria*, Busk, has a delicate rhizome, from which groups of zooecia arise. In the only specimen (which is now in the British Museum) it is growing upon the stalk of a seaweed, and this was mistaken for the stem of *Hippuraria*. There is, therefore, now absolutely no reason for separating *Hippuraria* from *Triticella*.

† Loppens, K., "Bry. d'eau douce," Ann. de Biol. lacustre, vol. iii. (1908) p. 9.

‡ Ann. Mag. Nat. Hist. ser. 3, vol. i. p. 169, pl. 7 (1858).

§ "Monog. des Bry. d'eau douce," Bull. Soc. Zool. de France, vol. x. (1885) p. 95, figs. 248–250.

|| Annandale, "Affinities of *Hislopia*," Journ. Proc. As. Soc. Beng. n. s. vol. ii. n. 3, pp. 59–63.

Amathia.

All the specific characters used so far depend upon the position of the zoœcia or the size of some part of the colony.

The zoœcia are attached directly to the stem without any intermediary growth, and at the base of each zoœcium there is a rosette plate; the zoœcia have a gizzard and 8–10 tentacles; there is no rhizome; and the zoœcia are connate nearly the whole length, whereas in *Zoobotryon* and other genera of the Vesicularina they are free or partly so. The zoœcia are biserial, the series in some species forming a straight row along one side of the stem, in others forming more or less of a spiral, and the series may continue the whole length of the stem or may only cover a small portion near the bifurcation. The branches usually dichotomize, or there may be a main stem from which branches arise as in *A. plumosa*, MacG., while in *A. Wilsoni*, Kirkp., there are three branches at a node.

In some cases the terminal branches extend beyond the group of zoœcia, gradually diminishing in size, being divided by one or more dissepiments, the position of which furnishes useful classificatory characters. The spiral is usually definitely in one direction right or left in a species; but this is not universally the case—for example, in *A. convoluta*, Lamx., there may be a right curve in the older, and a left in the younger parts of the same colony.

In the present investigation I found that in *A. semiconvoluta* there is a light oval mark at the proximal end of each node (Pl. **24**. fig. 6), and a radicle to a few of the stems explained the meaning.

A similar light mark occurs in *A. brasiliensis*, Busk, and Busk mentioned the rooting of his *A. tortuosa=convoluta*; also radicles occur in *A. obliqua*. The partial or complete formation of a radicle chamber to each zoœcium or at regular intervals, even although few radicles may be formed, occurs in many species of Bryozoa.

In the northern hemisphere the only form with a straight row of zoœcia is the cosmopolitan *A. lendigera*, L., whereas in Australia this group is well represented by nine species; on the other hand, the group with the spiral series of zoœcia is well represented in the northern hemisphere. So far as I am aware, no *Amathia* has yet been found in the Arctic or Antarctic. Although we must not arrange classification according to geographical distribution, yet it may often be examined to give a check to the correctness of classification*.

* The following table shows the distribution of the species, so far as can be judged from the descriptions. Species occurring in more than one region are printed in small capitals:—

Atlantic:—A. DISTANS, Busk; A. VIDOVICI, Hell. [the 'Challenger' specimens named *A. lendigera* are *A. Vidovici*, Hell., and in several other cases Busk does not seem to have recognised the difference]; A. LENDIGERA, L.

British and neighbouring seas:—A. LENDIGERA, L.

AMATHIA TORTUOSA, *Tenison-Woods* (non *Busk*). (Plate **24**. fig. 5.)

Amathia tortuosa, Tenison-Woods, Proc. Roy. Soc. Vict. vol. xvi. (1880) p. 89, fig. 6; MacGillivray, Prod. Zool. Vict. dec. xix. (1889) p. 308, pl. 185. fig. 3; Proc. Roy. Soc. Vict. vol. vii. (1894) p. 134, pl. A. fig. 4.

Amathia connexa, Busk, Polyzoa, Zool. Chall. Exp. vol. xvii. (1886) pt. 1, p. 35, pl. 6. fig. 3.

The specimens from the Sudan are about the same size as that figured by Tenison-Woods, but are a trifle smaller than the 'Challenger' *A. connexa*, B. The stem is about 0·2 mm. diam., and the wall is thin and transparent. The zoœcia are arranged spirally round the upper two-thirds of an internode.

A. distans, B. (Pl. **24**. fig. 7), *A. tortuosa*, T.-Woods (fig. 5), *A. brasiliensis*, Busk, and *A. semiconvoluta*, Lamx. (fig. 6), all form an incomplete spiral round the stem and only occupy part (more than half) of the internode, and from the descriptions determination is most difficult. However, the stem of *A. distans* is thin (0·12 mm. diam.) and chitinous; *A. tortuosa* has a colourless transparent stem much thicker (0·2 mm. diam.), whereas *A. semiconvoluta* has a dark chitinous stem (0·25 mm.), being altogether a larger species. *A. convoluta*, *A. semiconvoluta*, *A. spiralis* all have long zoœcia.

Loc. Port Jackson (*T. W.*); New South Wales (*MacG.*); off Cape York (*B.*); from s.s. 'Thyra' docked in Suez from Mediterranean (9), collected by Crossland.

ZOOBOTRYON PELLUCIDUM, *Ehrenberg*. (Plate **4**. fig. 12, 15.)

Zoobotryon pellucidus, Ehrenberg, Symbolæ Physicæ, pt. ii. Evertebrata (there is no paging), pl. iii. fig. 10 (1831); Reichert, "Vergleichende anatomische Untersuchungen über *Zoobotryon pellucidus*," König. Akad. Wissensch. Berlin, 1870; Phillips, Willey's Zool. Results, pt. iv., Cambridge, p. 450 (1899).

Hydra verticillata, Delle Chiaje, 'Memorie sulla storia e notamia degli animale senza vertebre del Regno di Napoli,' vol. iii. (1828) p. 203, pl. 47. figs. 1, 2.

Zoobothryon (sic) *verticillatum*, Delle Chiaje, "Desc. e Notam. degli anim. invert. della Sicilia citiore osservati vivi negli anni 1822–30," vol. v. p. 142, vol. vi. (1841) pl. 79. figs. 1, 2.

Hyalosiphon verticillatus, v. Martens, Ital. p. 453 (1844).

Serialaria Couthinii, F. Müller, Troschel's Arch. für Naturgesch. vol. i. (1860) p. 311, pl. 13. figs. 1–7.

Mediterranean:—A. LENDIGERA, L.; A. SEMICONVOLUTA, Lamx.; A. VIDOVICI, Hell.

Red Sea:—A. TORTUOSA, Woods.

Indian Ocean and Zanzibar:—A. DISTANS, B.; A. SEMICONVOLUTA, Lamx.; A. VIDOVICI, Hell.

Australian:—*A. cornuta*, Lamx.; *A. Brongniartii*, Kirkp.; A. BISERIATA, Krauss; A. DISTANS, B.; *A. spiralis*, Lamx.; *A. obliqua*, MacG.; *A. pinnata*, Kirkp.; A. TORTUOSA, Ten.-Woods; *A. plumosa*, MacG.; *A. bicornis*, T.-Woods; *A. convoluta*, Lamx.; *A. Woodsii*, Goldstein; A. LENDIGERA, L.

S. Africa:—A. BISERIATA, Krauss.

Dedalæa mauritiana, Quoy & Gaimard, Voyage de l'Uranie, vol. iv. p. 229, pl. 26. figs. 1, 2; Voyage de l'Astrolabe, p. 952, pl. xxvi. figs. 1–7.

Bowerbankia biserialis, Hincks, "Polyzoa of the Adriatic," Ann. Mag. Nat. Hist. ser 5, vol. xix. (1887) p. 309, pl. 9. fig. 6.

Vesicularia bilateralis, MacG. Trans. Roy. Soc. South Australia, p. 30, pl. 2. fig. 4 (1889).

Description of a Ctenostomatous Polyzoa, J. D. Macdonald, Proc. Roy. Soc. vol. viii. (1857) p. 383.

This has also been described in botanical works under various names as *Ulva intricata*, Clemente; *Valonia intricata*, Agh.; *Ascothamnion intricata*, Kütz.; *A. Trinitatis*, Sond.

Further particulars are given by Reichert and by Miss Jelly in her Catalogue.

This may be said to be Ehrenberg's type of Bryozoa, and was correctly and fully described by him. He saw the setose collar, as it has been called, also the gizzard, and gave the number of tentacles as eight.

Round this species there have been discussions not only as to whether it was a plant or an animal, but also as to whether the mesenchym threads were a colonial nervous system or a colonial organ of movement. When Hincks met with this classical genus he did not recognise it, and called it *Bowerbankia biserialis*, Hincks; however, thereby he unconsciously showed the identity of *Bowerbankia* with *Zoobotryon*, so that by the laws of nomenclature we are forced to drop the well-known genus and replace it by *Zoobotryon*, which will not be reverting to a disused name, but merely showing the identity of what have been understood as two genera. It is true that Hincks only speaks of two opposite branches at a joint, and in younger branches of *Z. pellucidum* this is often the case; besides Hincks's fig. 6 *a*, pl. 9, so far as I can understand it, shows two thick branches and a short terminal one, so that although the description does not correspond in this one particular, I think we may feel satisfied that *biserialis* is a synonym.

Ehrenberg first spoke of the "collare setosum," and Busk subsequently made the setose collar a distinctive character of his suborder Ctenostomata. In *Zoobotryon* there is no real setose collar, but the thin membrane is ridged and folded, and the lines of the fold give the appearance of separate setæ, but with higher powers it is clear that the membrane is continuous. The structure is correctly shown by Reichert, pl. 1. fig. 3, and by Ehlers for *Hypophorella expansa*, pl. 2. fig. 10, and some other term would have been more satisfactory, but neither "fringe" (*Hincks*) nor "bristles" is any better. In consequence of seeing that this collar is not divided in *Zoobotryon pellucidum* a large number of Ctenostomata have been examined without ever finding true setæ on the collar. At the time this examination was made it had escaped me that Jullien * had shown how this collar simulates by its folds a bundle of setæ. Busk, in his 'Challenger' Report, p. 37, says that

* Mission du Cap Horn, p. 15.

Farella repens and *Farella elongata* have no setæ, but I find the collar is well developed in these species.

The gizzard of this group of the Ctenostomata was not quite correctly described by the earlier authors, and the only exact figures of the structure with which I am acquainted are those of Calvet *. In cross-sections there are from 30–50 teeth, varying much in the formidable terminations, which stain much darker than the rest. The ends in *Zoobotryon pellucidum* may be spear-headed, hammer-headed, two-pronged, or reflex uncinate.

There are two sets of larger teeth opposite one another, and it is these that are most noticeable, when the animal is alive or in whole mounts. Sections (Pl. **24**. fig. 15) show that the muscular wall of the gizzard has sometimes separated from the teeth, and then the contents of the teeth are attached to the muscular wall and are more or less drawn out of the teeth. I have found identically the same separation of the contents in *Bowerbankia imbricata*, Adams, and *B. pustulosa*, Soland. We cannot therefore speak of this as a nucleus of the teeth. Calvet † mentions a conical cavity enclosing a protoplasm "pauvre en granulations, et un noyau dont le situation est variable."

The gizzard of *Cryptopolyzoon*, Dendy, is quite different to any other known gizzard, and as Dendy described it there are "two relatively large chitinous teeth"—"squarish in shape and flattened"—"planted within the muscular mass."

This being so diametrically different from other gizzards, I was anxious to make sections, and the British Museum authorities kindly allowed me to prepare some sections from their preserved material. The zoarium is covered with sand-grains and the walls of the zoœcia are thick chitin, so that even after much labour only moderately successful results were possible. However, the gizzard was found to have very thick and powerful muscles surrounding the two teeth (Pl. **25**. figs. 1, 2, 3), which present two flat surfaces to one another, with slight projections near the border. These gizzards occur near the "cardiac portion of the digestive system," and I distinguish them from other gizzards as being of the grindstone type. It will be noticed in comparing my figures of *Cryptopolyzoon* and *Zoobotryon* &c. that the gizzard and the zoœcia of the first are small (Pl. **25**. figs. 1, 2, 3). The zoœcia are placed close together, sometimes partly attached as in *Amathia*, and from the chitinous wall there are slight projections ending in a disk-like knob which is attached to the grains of sand. The number of zoœcia is very large in each node of *C. Wilsoni*, Dendy ‡. We must beware of judging without sufficient examination whether there are gizzards in any species, and it is naturally

* Bryozoaires Ectoproctes Marins, pl. 7. figs. 4, 8.

† Bry. Ectoproctes Marins, p. 230.

‡ Arthur Dendy, "On the Anatomy of an Arenaceous Polyzoon," Proc. Roy. Soc. Vict. vol. i. (1888) n. s. p. 1, pls. 1, 2, 3; "*Cryptopolyzoon*, an Emendation in Nomenclature," Zool. Anzeiger, vol. xxiii. (1900) No. 620. [*Cryptopolyzoon Wilsoni*, Dendy, also occurs from Knysna, S. Africa (*fide* Kirkpatrick).]

the presence of these teeth, either numerous and pointed as in various species, or the flat grindstones, which proves the existence of the gizzard.

So far as we know, gizzards do not occur in most of the Ctenostomata, but they are known in *Zoobotryon* (*Bowerbankia*), *Amathia*, *Vesicularia*, *Hypophorella* (?), *Buskia socialis*, Hincks (A. W.), *Victorella* (?), *Cryptopolyzoon*. They do not occur in *Farella*, *Mimosella*, *Cylindrœcium*, *Alcyonidium*, *Pherusa*, *Valkeria*.

For some time I have been on the look-out for attached specimens of *Zoobotryon*, and at last found some attached to a seaweed from Boa Vista, Cape Verde Is. The spreading chitinous attachment is large, throwing out digitiform processes (Pl. **24**. fig. 12), and from the round basal cell the tubular stem of the colony grows and soon bifurcates, and there may be a second similar attachment close to it, but in no case have I seen any creeping stolon from which they grow. These spreading attachments are very similar to the anchors at the end of the radicles by which some of the *Cellularidæ* are fastened.

The mesenchym threads which have been the subject of Müller's and Reichert's papers are not the solid cords often represented and figured, but are bundles of fine protoplasmic threads with nuclei, and these threads spreading and anastomosing in all directions are constantly changing. None of the names by which the structure has been designated seem quite satisfactory. "Parenchym Stränge" of Vigelius seemed to express it the best, but this has not been found quite correct; the most frequently used "funiculus" is misleading, as we do not get a solid cord in the Cheilostomata or Ctenostomata like the funiculus as described in the Phylactolæmata, for in this sense no funiculus exists in the Cheilostomata. Many known figures only represent a pathological condition. However, the use of the term has been generally extended to include any of the threads passing to all the organs and to the rosette plates of the zoœcia, avicularia, ovicells, and radicles, and these changing threads take part in all new growth of bud ovaria, testes, avicularia, &c.

As mentioned in a previous paper, the first time I was in Naples I did not see *Zoobotryon*, but the second time I saw buckets full of nothing but *Zoobotryon* brought in.

The distribution of the zoœcia on the stem varies considerably; sometimes the lower part of a joint is bare or it may be covered, as in the specimen from Zanzibar. The younger portions are closely covered with zoœcia and buds.

Loc. Ehrenberg found it at Suez and Alexandria, and Reichert says from almost all seas of the temperate and tropical zones, but we have not further particulars. It occurs in abundance in Naples and Trieste; Miss Philipps found it from the Isle of Pines; South Australia (*MacG.*); from s.s. 'Thyra' from the Mediterranean docked in Suez, collecte after it had been there

one month (9) ; Boa Vista, Cape Verde Island ; and Chuaka Bay, Zanzibar (509), 2 fath., all collected by Crossland.

As we have dealt with the species which may be said to be Ehrenberg's type of Bryozoa, it has led me again to think why it is that Ehrenberg's term has not received universal acceptance in England, although nearly general elsewhere ; and the conclusion come to is that it is on account of the difficulty of putting ourselves back 100 years, when the thoughts and language of to-day had not become stereotyped.

Nearly thirty years ago * I wrote two short papers giving my reasons for adopting the term Bryozoa, and as I am not fond of polemical discussion I have continued to use it, without again raising the question.

At the time Ehrenberg and Thompson wrote, the discussion as to the animal nature of the zoophytes was comparatively recent, as but little work had been done and the phraseology used previously was largely retained. The animal in the zoophytes was hydra, as we still say Hydrozoa ; and Thompson studying the zoophytes was surprised to find that all the animals—that is to say, the polyps—in the zoophytes were not hydra, and he wrote a paper on "Polyzoa, a new Animal inhabiting certain Zoophytes." This idea of the Polyzoa inhabiting the zoophytes occurs every few lines, and he says "the animals of some Cellariæ, Tubuliporæ, and Flustraceæ proved to be Polyzoæ." We cannot consider the paper without remembering that Thompson used Polyzoa as a feminine singular, while it has now been changed into a neuter plural, by which the drift of Thompson's paper has been somewhat obscured.

Hincks says Polyzoa was used in opposition to Hydra. Certainly ; but we must not first surround it by our present ideas, with Hydra meaning a class to us, but must look upon Polyzoa as in opposition to Hydra of that time, namely, the polyp of Hydrozoa &c.

I am unable to find anywhere in the paper that Thompson considered that he was giving the name Polyzoa (a singular name) to a class ; and if we read the paper in the sense of Polyzoa meaning a polypide, the contribution becomes consistent instead of being most confused.

As a young man when I presented papers, those in authority said, you should not use Bryozoa when Busk and others use Polyzoa. I pointed out my reasons and induced them to examine Thompson's paper, and they all, without exception, said they considered I was quite right and that there could not be any question of Thompson using Polyzoa as a class name. Such able literary and scientific critics as Mr. Dallas and Dr. Francis became quite convinced, and Mr. Dallas † in a review of Hincks's book put the question more clearly than it has been put by anyone else. A number of members of

* Ann. Mag. Nat. Hist. ser. 5, vol. v. (1880) p. 34.

† 'Popular Science Review,' n. s. No. 14, April 1880.

the staff of the British Museum working upon invertebrates met together to examine Thompson's paper, and unanimously came to the conclusion that Polyzoa was not given as a class designation.

Bryozoa was for a long time used in England, and then Busk introduced Polyzoa as being Thompson's name. I was not surprised that Busk, Allman, and Hincks, who had worked together, did not change, but I felt confident that the change would soon be made by a younger generation. In this I seem to have been mistaken, and so long as any of our leaders use Polyzoa we must recognise that there are two sides to the question, though I find it very difficult to understand how this can be if we try to divest ourselves of the knowledge gained since Thompson's time and put ourselves in his position.

BOWERBANKIA IMBRICATA (*Adams*). (Plate **25**. figs. 6–10.)

Sertularia imbricata, Adams, Trans. Linn. Soc. vol. v. (1800) pl. 2. figs. 5-11.

Miss Jelly's list of synonyms may be consulted and add :—

Bowerbankia imbricata, Hincks, Ann. Mag. Nat. Hist. ser. 5, vol. xix. (1887) p. 309; Levinsen, Zool. Dan. vol. iv. (1894) p. 82, pl. 8. figs. 5-9; Robertson, "Bryozoa," Proc. Washington Acad. of Sciences, vol. ii. (1900) p. 331; Calvet, "Bry. Mar. de Cette," Trav. Inst. de Zool. de l'Univ. de Montpellier, 2nd ser. Mem. 11, p. 90 (1902); Nordgaard, "Hydr. & Biol. Investigations," Bergens Mus. p. 174, pl. 3. fig. 36 (1905); "Bry. from the 2nd Fram Expedition," p. 39 (1906); Loppens, K., "Bry. marins & fluv. de la Belge," Ann Soc. R. Zool. & Malac. de Belge, vol. xli. (1907) p. 308, fig. 22.

At first the specimen from the Sudan was taken to be *B. caudata*, Hincks, on account of the process at the base of the zoœcium, but this is not a character confined to one species, and I find processes on both *B. imbricata*, Adams, and *B. pustulosa*, E. & S., from Poole. These are usually bifurcate or forked and their function has not been generally understood, but they are small rooting processes attaching themselves to seaweed &c., as is seen in some Red Sea specimens. Radicles, as a rule, are separate chambers, only connected to the zoœcial chambers through a diaphragm or rosette plate, whereas here they are only a swelling of the zoœcial wall. Such a growth is not entirely unknown in the Cheilostomata, and I have referred to it in *Schizoporella argentea*, Hincks *. These processes are in parts formed on all the zoœcia, although only a few may find an attachment; just as in many Cheilostomata there is a radicle chamber where no radicle is formed. Jullien † partially recognised the meaning of these processes when describing his *Bowerbankia minutissima*, and says: "autour de cette base existent des sortes de processus ou de crampons fixant la zoœcie au support colonial." It is at present impossible to recognise any of Jullien's species, and no figures are given.

Levinsen ‡ mentions and figures these processes in both *B. imbricata* and

* Journ. Linn. Soc., Zool. vol. xxxi. (1908) p. 146.

† Mission du Cap Horn, p. 21.

‡ Zool. Danica, "Mosdyr," p. 82, pl. viii. figs. 3, 6.

B. caudata, showing them sometimes branched, and considered them to be the commencement of a new outrunner from the stem.

Loppens * calls *B. caudata* a variety of *B. imbricata* and says: "loges fixées latéralement au stolon, terminées en pointes, on trouve fréquemment les deux formes dans une même colonie." Surely, then, it is not a variety, and I agree with Loppens in thinking that *B. caudata* is not a good species; but Hincks says that it is much smaller than *imbricata,* so that in all probability it is only *B. pustulosa,* in which we know that these zoœcial attachments occur. Ostroumoff † figures processes from the side of his *Vesicularia stationis.* I am not sure what this is, for Ostroumoff regards it as most closely allied to *Valkeria uva,* but he figures a gizzard. Probably *V. stationis* is *Bowerbankia.*

B. imbricata is a much stouter species than *B. pustulosa,* with a much larger gizzard, furnishing a useful character in determination. Many of the determinations of both species require confirmation, for in the earlier descriptions there is inextricable confusion between *B. imbricata, B. pustulosa,* and *Valkeria uva,* for all three species may form thick growths over seaweed as described under the name *densa.* Thompson, in his figure of *Valkeria cuscuta,* shows a gizzard, proving that he had the zoœcium of some other species before him; also Smitt mixed up *Valkeria uva* and *Bowerbankia imbricata,* which accounts for his saying sometimes with and sometimes without a gizzard. The muscles of the gizzard show cross-lines in section (Pl. **25**. fig. 9), and the same is the case in the muscles of *B. pustulosa.*

The *Farella arctica,* Busk, which is in the British Museum, is but a very poor specimen, and is apparently *Bowerbankia,* certainly not *Farella.*

The gizzard of *Bowerbankia imbricata* is the largest of any that have come under my notice, measuring in sections about 0·1 mm. transversely in an ordinary non-inflated condition; *Zoobotryon pellucidum* about 0·08 mm.; *Bowerbankia pustulosa* about 0·07 mm.; *Amathia Brongniartii,* Desm. & Les., 0·07 mm.; *Buskia socialis,* Hincks, about 0·07 mm.; *Amathia lendigera,* Linn., about 0·05–0·06 mm.; *Vesicularia spinosa,* L., about 0·04–0·05 mm.; *Cryptopolyzoon* about 0·02–0·03 mm.

There seems no character yet described by which *Bowerbankia* can be distinguished from *Zoobotryon,* but it is provisionally left until the whole of the Ctenostomata have been fully studied.

Loc. Arctic; Danish, Belgian, French, and British coasts; Mediterranean; Alaska; California, Queen Charlotte Island (*Robertson*); Caspian Sea (fide *Grimm*); Bay of Agig Suraya (south part of Sudan coast, 21), collected by Crossland.

* "Bry. Marins et Fluviatiles de la Belgique," Ann. Soc. Roy. Zool. & Malac. de Belgique, vol. xli. (1996) p. 286.

† "Études Zool. & Morph. des Bry.," Arch. Slaves de Biol. vol. i. (1886) p. 567, pl. 4 figs. 49–52, pl. 5. fig. 64. (This is a translation of a Russian paper.)

VALKERIA UVA (*Linn.*). (Plate **24.** fig. 13 ; Plate **25.** figs. 4, 12, 13.)

Ellis, J., Nat. Hist. of Corallines, p. 28, Corallina cuscutæ forma &c. pl. 14. fig. C, and Corallina minima repens &c. p. 28, pl. 15. fig. C.

Compare Miss Jelly's Catalogue and add:—

Valkeria uva, Lomas, "Report on Polyzoa," Proc. Lit. Phil. Soc. Liverpool, vol. xl. (1886) p. 189; Levinsen, Zool. Danica, "Mosdyr," p. 83, pl. 8. figs. 10, 11 (1894); Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. v. (1890) p. 17; Calvet, "Bry. Mar. de Cette," Trav. Inst. de Zool. de l'Univ. de Montpellier, 2nd ser. Mem. 11, p. 93 (1902); Bidenkap, "Fort. over de arkt. Bry.," Bergens Mus. No. 9, p. 44 (1905).

Vesicularia cuscuta, Barrois, "Rech. sur l'Embry. des Bry." p. 199, pl. 11. figs. 1–14 (1877).

Valkeria verticillata, Heller, "Bry. Adr. Meeres," Verh. zool.-bot. Gesellsch. vol. xvii. (1867) p. 129, pl. 6. fig. 4.

Valkeria tuberosa, Heller, *loc. cit.* p. 129, pl. 6. fig. 3.

The creeping form occurs abundantly from Naples, and the number of zoœcia in a group varies considerably; some will have 6–7, whereas I have seen some with as many as 40–50. Those from the Sudan have usually 10–12, but they are attached to *Lepralia japonica* in such a way that they cannot readily be studied.

In specimens with a large number of zoœcia it is seen that a joint is given off from the main stem, and then from this joint two other creeping joints, which again give out a pair, and so on (Pl. **24.** fig. 13). From each short joint grows a zoœcium, thus forming groups of long narrow zoœcia, except where there is a larva, when they are wider and shorter. Possibly those just described with numerous zoœcia should be called var. *tuberosa*, Heller. The distance between these groups is considerable though variable, and in the same way *Bowerbankia pustulosa* and *B. imbricata* have distant groups, though sometimes all three form dense masses. In examining some specimens from Poole out of the so-called salt-water lake (which varies much in saline density), I found that when the groups are forming there is below the septum of the stem a pair of zoœcia (fig. 12), and then immediately below these a pair of growths, which may remain delicate root-like processes, or these may grow to form new stems or occasionally may form zoœcia.

In the slight swelling of the stem from which the zoœcia grow a bundle of muscles is found passing from the upper to the lower surface (see Pl. **25.** figs. 12, 13), and these agree with what Ehlers has figured in *Hyphoporella expansa*, and what we also find in *Farella repens*, Farre. In *Mimosella gracilis*, Hincks, there is in the pinnæ, below each septum, a similar band of muscles (see note p. 239). The creeping stolon is about 0·04–0·05 mm. in diameter, the zoœcia about 0·30 mm. long when closed, so that it is easily distinguished from *Bowerbankia pustulosa* and *imbricata* by being so much smaller. The parietal muscles are grouped and there are two series of muscles, though Farre thought that there was only one "set." Whether the

genus *Valkeria* ultimately stands or not, we cannot have *V. uva* and *Farella atlantica*, Busk, in two genera.

Loc. Northern seas; British, Danish, Belgian, and French coasts Mediterranean; China seas; Agig Suraya (in the south part of the Sudan coast), on *Lepralia japonica*, B. (21); Chuaka, Zanzibar (508), collected by Crossland.

CYLINDRŒCIUM DILATATUM (*Hincks*).

See Miss Jelly's list and add:—

Cylindrœcium dilatatum, Calvet, "Bry. Ectoproct." pl. 7. figs. 12, 13; Thornely, "Manaar," p. 128; Record Indian Mus. p. 196; Prouho, Arch. de Zool. Exp. & Gén. 2nd ser. vol. x. (1892) p. 626, pl. 24. figs. 14–17.

The zoœcial wall has very fine latitudinal lines close together, but they cannot always be seen on account of the covering foreign matter. There are about 20 tentacles. The creeping stolon is 0·02 mm. in diameter, whereas in *C. giganteum* it is 0·03–0·04 mm. I have a specimen from Naples believed to be *Cylindrœcium* with a stout chitinous creeping stolon, and the zoœcia are long and wide. Busk's figure of "*Farella gigantea*" shows a large creeping stolon.

Prouho has shown that a swelling takes place at the side of the zoœcial tube near the distal end, and that the ova establish themselves in the cavity thus formed and then escape through a tube which develops from the swelling. None of the specimens of *Cylindrœcium* which have come before me have been in this stage.

Loc. Arctic; British; French; Mediterranean; Manaar, 7–10 fath.; Mangalore, Indian Ocean, 26–31 fath.; Ras el Millan, Sinai Coast, collected by Hartmeyer.

CYLINDRŒCIUM GIGANTEUM (*Busk*).

For synonyms, see Miss Jelly's Catalogue and add:—Calvet, "Bry. d Cette," Tr. Inst. Zool. Montpellier, ser. 2, Mém. 11, p. 91 (1902); Talisman & Travailleur, p. 371 (1907).

Loc. Queen Charlotte Islands; British; Naples; Cette; Adriatic; Corsica; Ceylon; Ras el Millan, collected by Hartmeyer.

ENDOPROCTA.

BARENTSIA GRACILIS (*Sars*).

For synonyms, see Miss Jelly's Catalogue and add:—

Ascopodaria gracilis, Kirkpatrick, Ann. Mag. Nat. Hist. ser. 6, vol. ii. (1888) p. 21; Norman, "Polyzoa of Madeira," Journ. Linn. Soc., Zool. vol. xxx. (1909) p. 277.

Pedicellina gracilis, Levinsen, Zool. Danica, p. 96, pl. 9. fig. 30 (1894).

In my Report on the 'Belgica' Antarctic Bryozoa I showed that *B. discreta* has in some stalks of a colony a node and that on this account the genus

Gondypodaria must fall. These muscular nodes occur in some stalks but not in all of the specimens of *B. gracilis* from the Sudan (3), and the same thing is known in British and Mediterranean specimens. It is referred to by Joliet in his Bry. des Côtes de France, p. 104, and also by Levinsen in his Zool. Danica, p. 96. In one instance the calyx arises from this second muscular node, which also seems to be the case in *B. ramosa*, Robertson.

In specimens from No. 3 Sudan there are delicate spines round the calyx and also on the non-chitinous parts of the stalk, but some calyces may have only one or two spines or none; and examination of specimens from other localities shows that this is not exceptional, for they occur on my Trieste specimens and on some shown to me by Mr. Waddington from Poole, and on others I collected near Bournemouth, though they may in some cases be overlooked if only examined with very low powers. There is thus no reason for making a new species, even though the spines are stouter than those found elsewhere.

Similarly, there are in my specimens of *B. cernua*, Pall., sometimes spines on the calyx, and Hincks, Joliet, and some others have considered that *Pedicellina cernua*, P., and *P.* var. *glabra*, Sars, are the same species, with the stalk sometimes smooth, sometimes spiny; nevertheless Ehlers considered them to be distinct species, though from what I have seen there seems no doubt that Hincks was correct and that the presence of spines is not a character of the first importance.

Spines occur both on the stalk and the calyx on Jullien's *P. hirsuta* and on Miss Robertson's *Myosoma spinosa*, which I am not at present prepared to remove from *Barentsia*. Miss Robertson mentions the oblique position of the calyx, but this appearance is sometimes seen in *B. cernua*, and her figure (pl. xvi. fig. 3) suggests that there is here no structural difference of great importance. Sars, in his original description of *B. echinata*, figures and mentions spines on the calyx. In a specimen in my collection from Naples, which otherwise resembles *B. echinata*, there are about 100 stout recurved spines, which also spread out at the base as if they were attached by muscles, and there are also numerous stout spines on the stalk.

Loc. Arctic, British, Danish, French, Mediterranean, Victoria (Australia), Queensland; Khor Shinab (3) on *Membranipora limosa*, Wat., 10–12 fath., collected by Crossland.

Loxosoma Kefersteinii, *Claparède.*

A large specimen with many buds from Khor Dongola is no doubt this species, but I was unable to make any detailed examination.

Loc. Naples (*Cl.*), Adriatic (*Hincks*), Khor Dongola, collected by Crossland.

ADDENDA.

AETEA CROSSLANDI, sp. nov. (Plate **24**. fig. 8.).

Pieces of dry seaweeds covered with this species were quite recently sent to me, and, as it is a most interesting species, it seems advisable to add a description to the present communication.

The creeping portion of the zoœcium is narrow pear-shaped, diminishing at the proximal end to a narrow tube; the erect tubular portion is long and narrow, reaching in some cases to 2 mm.; neither part is ringed or spotted, but both are annulated. A new zoœcium arises from the distal end, but sometimes a creeping zoœcium arises from the side. There are also frequently very interesting appendages growing erect from the side: at first they are small tubes; then next they take the form of a coachman's horn; then laterally from the end there is a short tubular prolongation with a very short area, but in other respects corresponding with the ordinary tubular prolongation; then, finally, laterally in the other direction there is a narrow short tube, and in one case this produces an appendage like the one just described. This seems to be a case of small erect zoœcia growing from the older zoœcia. There are one or a pair of these appendages to the creeping zoœcium, though in one case there are several tubes on this creeping part.

This species looks much like the *Aetea ligulata* of Busk; but it is impossible to be sure from the description, and Busk's slide has dried up and nothing can be distinguished.

From Naples I have two mounted specimens of an *Aetea* with a large and creeping portion, and a thick tubular prolongation which is ringed. At the side of the creeping part there are two pairs of appendages (Pl. **24**. fig. 9) having so much the appearance of *Lepas* that I proposed the name *Aetea lepadiformis* for it (Ann. Mag. Nat. Hist. ser. 7, vol. xvii. p. 13). These appendages are probably similar in formation to those now described; but as it is impossible to understand them from dried specimens I have told Mr. Crossland how interesting the specimens are, and that I should like to have the opportunity of cutting preserved material.

In some specimens of *Aetea truncata*, Lands., from Naples, there are in many zoœcia, close to the tube which starts from the dorsal surface, a pair of jointed appendages; sometimes this dorsal tube is continued as a zoœcium, though in one or two cases it produces a minute zoœcium similar to the ordinary ones, but only about a quarter of the size. Both Smitt and Hincks appear to have seen such appendages, but their figures are not very characteristic and do not show that they are usually in pairs and jointed.

Loc. Khor Dongonab, March 3rd, 1909.

A specimen from the coral-nullipore reef Beacon Island, Khor Dongola, marked "violet-colored Polyzoan," is the Hydrocoralline *Distichopora violacea*.

Retepora abyssinica, var. expansa, nov.

Retepora abyssinica, Waters, pars, Journ. Linn. Soc., Zool. vol. xxi. p. 176, pl. 18. figs. 8, 9, 10.

In cleaning some pieces of Retepora (from 422) entirely covered with sponge I have come to the conclusion that they should be separated from *R. abyssinica* as a variety. The branches are slightly less stout than those of *abyssinica,* not so much in one plane, branching more frequently and occasionally anastomosing. The avicularium is in the aperture, directed laterally, and usually bifid, whereas in the type the avicularium is removed from the aperture and has a beak seldom bifid. The oral aperture in both is similar, with a labial pore, and there are in the peristome internal ridges giving the appearance of an oral sinus. The ovicells have a similar subtruncate lamina, and the dorsal surface has similar long narrow avicularia sometimes replaced by a pore.

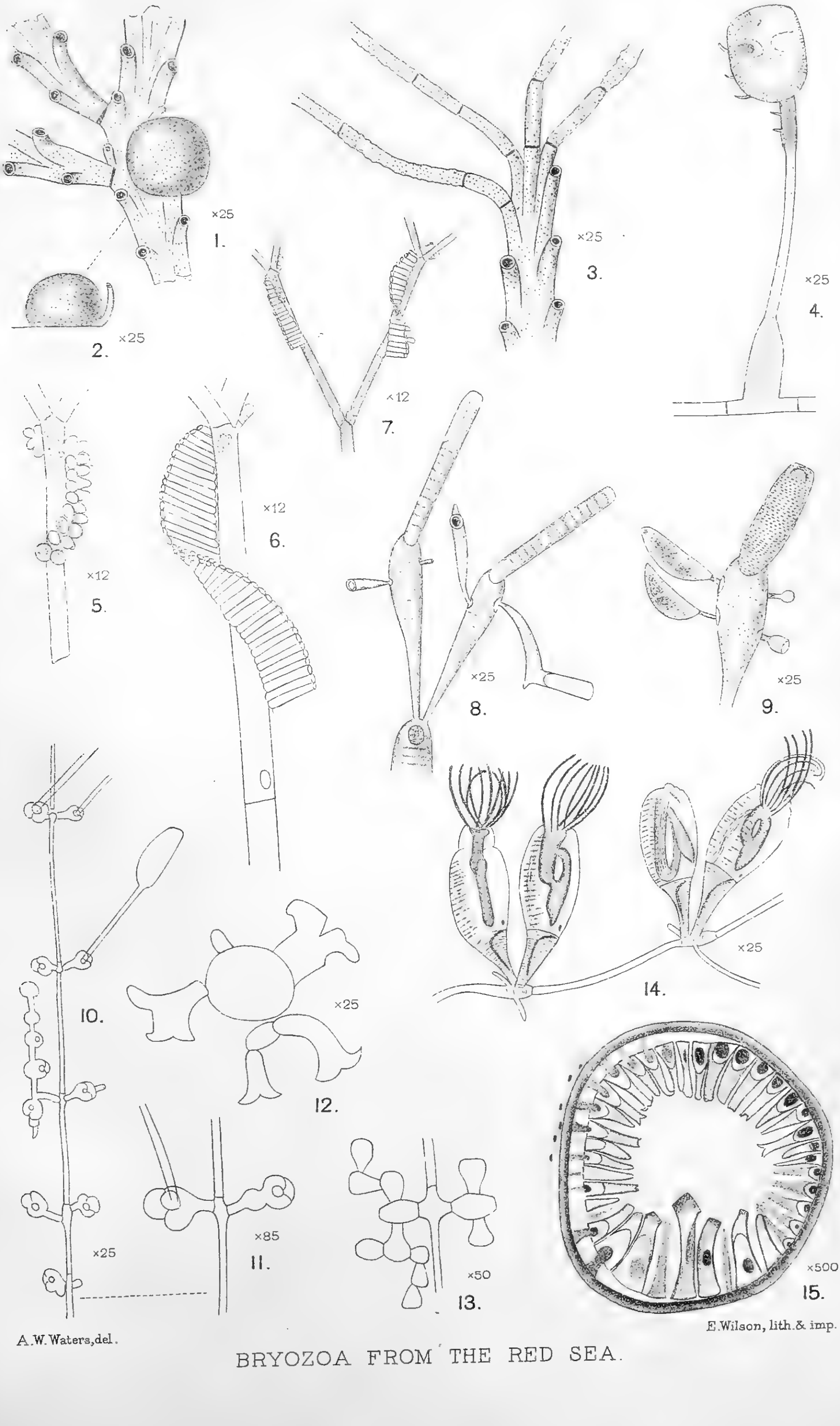
The only important difference is that the frontal avicularium instead of being close up to the aperture has a position nearer the middle of the zoœcium in the type and is larger and directed downwards.

Loc. Lat. 16° N., long. 41° E., 30 fath., collected by Siemens and Löffler. By a most unfortunate slip the type was referred to as from long. 41° W.

In a specimen of *Scrupocellaria Jolloisii,* Aud., from Ras el Millan, there is one raised somewhat lateral gigantic avicularium with a deeply furcate mandible, like that of *Retepora delicatula,* Busk. Although a large number of specimens were examined only this one gigantic avicularium has been found. When the radicles are long they are serrate at the end.

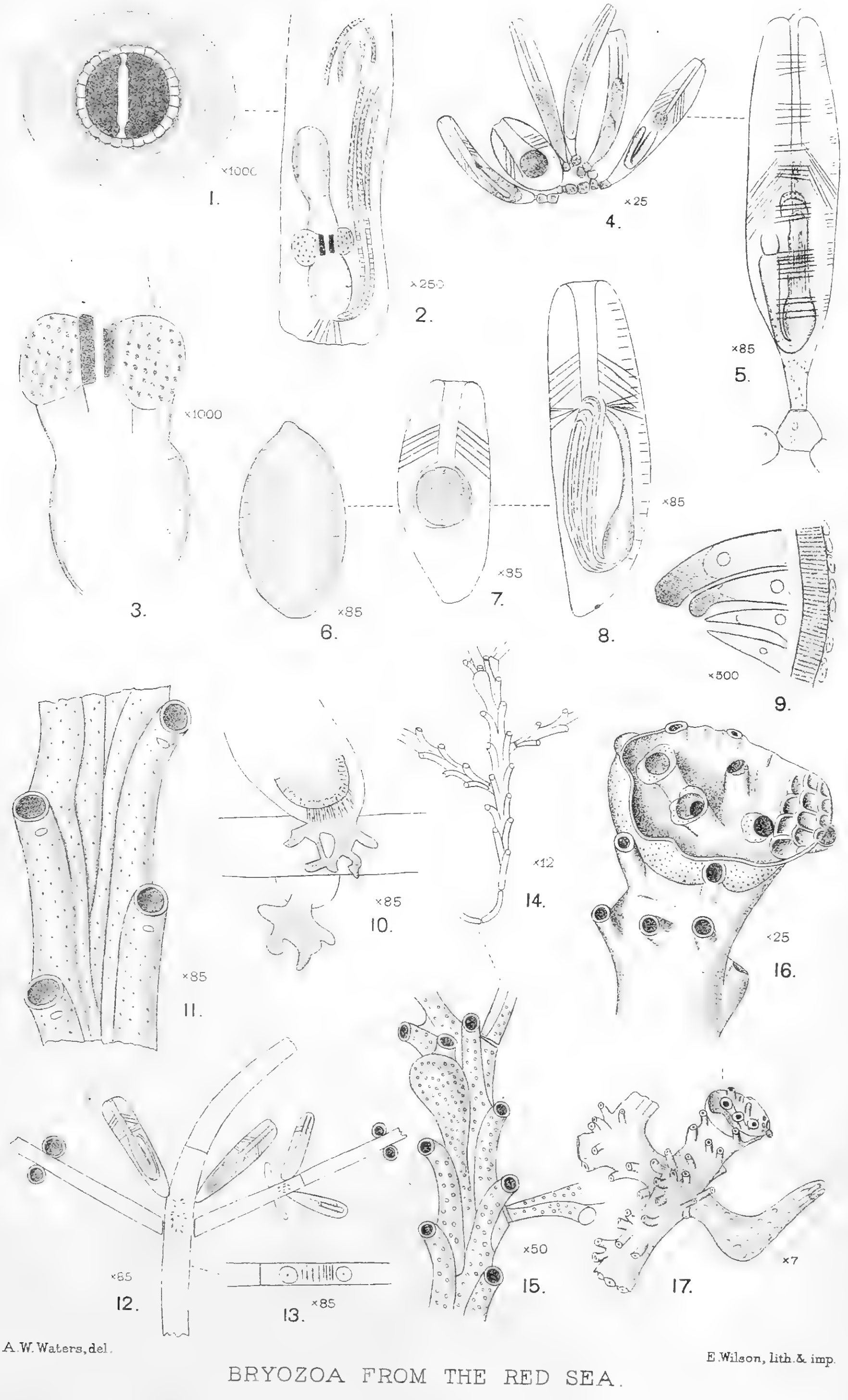
In *Holoporella pigmentaria,* Waters, Gimsah Bay, there are a considerable number of small hydroids (*Clava* or *Coryne*) projecting through the zoarium. The large pore alluded to belonging to the two neighbouring zoœcia (Journ. Linn. Soc., Zool. xxxi. p. 163, pl. 15. fig. 16) is for the passage of the hydroid. I have another *Holoporella* from Zanzibar infested in the same way by a hydroid.

It seems that the locality which is alluded to as Nersa Makdah should be Mersa Makdah, the label having been misread. This volume, pp. 129, 131, 132, 135, 137.



A.W. Waters, del. E. Wilson, lith. & imp.

BRYOZOA FROM THE RED SEA.



A. W. Waters, del.

E. Wilson, lith. & imp.

BRYOZOA FROM THE RED SEA.

EXPLANATION OF THE PLATES.

Plate 24.

Fig. 1. *Crisia denticulata*, Lamk. × 25. From Khor Dongola.
2. Do. do. Ovicell, × 25.
3. Do. do. × 25. Showing radicles growing from the distal end of zoarium.
4. *Barentsia gracilis*, Sars. × 25. Showing few spines on the calyx and stalk. From No. 3 Sudan.
5. *Amathia tortuosa*, T.-Woods (non Busk). × 12. From Suez (9).
6. *Amathia semiconvoluta*, Lamx. × 12. From Wasin, Brit. E. Africa.
7. *Amathia distans*, Busk. × 12. From Zanzibar (527).
8. *Aetea Crosslandi*, sp. nov. × 25. Khor Dongola.
9. *Aetea lepadiformis*, Waters. × 25. From Naples.
10. *Triticella Koreni*, Sars. × 25. Basal rhizome showing raised areas at intervals, from which the stalk of the zoœcium grows. From Kattegat, Denmark.
11. Do. do. × 85.
12. *Zoobotryon pellucidum*, Ehr. × 25. Basal growth with anchors.
13. *Valkeria uva*, L. × 50. The rhizome seen from below, showing chambers from which the zoœcia grow. From Naples.
14. *Farella repens*, Farre. × 25. Showing the creeping rhizome with the swellings from which a pair of zoœcia grow. As a rule only one develops, but then there is a short tube opposite the zoœcium. There are also two radicles which may remain minute, or develop and carry fresh zoœcia. From Poole.
15. *Zoobotryon pellucidum*, Ehr. Gizzard, × 500. Section showing the teeth and the thick muscular sheath surrounding it. It will be seen that where the muscular sheath has become separated the contents of the teeth are attached to it, and more or less drawn out of the teeth.

Plate 25.

Fig. 1. *Cryptopolyzoon Wilsoni*, Dendy. Transverse section of gizzard, × about 1000. This shows the two solid "teeth" surrounded by the very powerful muscles, and at each end of the tooth there are small protuberances. It will be noticed that this is much smaller than the gizzards of other species. From Port Phillip Heads, Australia. Drawn as seen under $\frac{1}{12}$ immersion.
2. Do. do. Longitudinal section through the zoœcium, × 250.
3. Do. do. Longitudinal section showing the two teeth and the sections of the muscular wall, × about 1000.
4. *Valkeria uva*, L. × 25. Showing group of zoœcia growing on joints. From the Sudan (21).
5. Do. do. × 85. Zoœcium showing the parietal muscles.
6. *Bowerbankia imbricata*, Hincks. × 85. Showing empty zoœcial chamber.
7. Do. do. Showing zoœcium with larva.
8. Do. do. Showing ordinary zoœcium.
9. Do. do. × 500. Small portion of gizzard with the surrounding muscles.
10. Do. do. × 85. Showing the radicle processes at the base of a pair of zoœcia. From Poole.
11. *Crisia denticulata*, Lam. × 85. Showing the light thin mark below the aperture. From the Sudan (19).

Fig. 12. *Valkeria uva*, Linn. × 85. Portion from near the growing end, showing a pair of zoœcia and immediately below a pair of processes which may form radicles or grow into fresh branching stems, or even sometimes into fresh zoœcia. The attachments of muscles, in the stem, below the septum are also shown. From Poole.

13. *Valkeria uva*, Linn. × 85. Stem seen from the sides, showing the zoœcial and stem rosette plate, and the muscles below the septum.

14. *Crisia cylindrica*, Busk. × 12. From Gimsah Bay.

15. Do. do. × 50. From Gimsah Bay.

16. *Filisparsa tubulosa*, Busk. × 25. Showing the ovicell in course of formation. The finely perforated wall is commencing to grow from the frontal wall and from the wall of each zoœcium. From Ras el Millan.

17. Do. do. × 7.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—XVI. PYCNOGONIDA from the RED SEA and INDIAN OCEAN, collected by Mr. CYRIL CROSSLAND. By GEORGE H. CARPENTER, B.Sc. Lond., M.R.I.A., Professor of Zoology in the Royal College of Science, Dublin. (Communicated by Prof. W. A. HERDMAN, F.R.S., F.L.S.)

(PLATES **26** & **27**.)

[Read 16th December, 1909.]

THROUGH the courtesy of Prof. Herdman of Liverpool and Dr. W. T. Calman of the British Museum, I have been entrusted with a few examples of "sea-spiders" collected on the east coast of Africa by Mr. Cyril Crossland. They prove to belong to undescribed species of the widespread genera *Nymphon* and *Pallenopsis*.

The localities from which these specimens were obtained lie to the north and east of the district surveyed by Prof. Stanley Gardiner, whose collection of Pycnogonida I have recently (1907) described. The present short contribution may be regarded as supplementing, to some extent, the account of Prof. Gardiner's collection, and I use here the same terminology as in that paper (*l. c.* pp. 95–6).

Family **Nymphonidæ**.

NYMPHON, *Fabr.*

NYMPHON MACULATUM, sp. nov. (Plate **26**. figs. 1–9.)

Male, length 6 mm. (including proboscis).

Head half the total length of the body, neck slender and elongate. Pro-

boscis short and stout. Leg-bearing segments slender, with processes well separated. Abdomen very short (fig. 1). Eye-eminence prominent with somewhat blunt apex, eyes large (fig. 2). Chelifori small, but with "hand" and "finger" relatively elongate, strongly curved, and armed with prominent teeth (fig. 3). Palp with 2nd segment longest, 3rd and 4th subequal, 5th about a half shorter than either of latter (fig. 4). Oviger with elongate 5th segment; denticulate spines on terminal segments comparatively simple, usually with four serrations on each side (figs. 5, 6). Legs, like body, smooth, almost devoid of spines; 2nd coxal segment four times as long as the first; thigh rather shorter than 1st tibial segment, which is about equal in length to the 2nd tibial segment (fig. 1); propodus two and a half times as long as tarsus, bearing a rather broad claw and slender elongate auxiliary claws; a few feeble spines and bristles beneath the propodus (fig. 8). The colour of the animal is yellow with scattered black spots (fig. 1).

Habitat. Port Sudan Harbour, Red Sea; on a buoy among crowded *Margaritifera vulgaris*, June 1906. Three males, one with eggs. (Type in Zoological Museum, Liverpool.)

The very elongate neck and body together with the short abdomen, excessively long 2nd coxal segment, and well-developed auxiliary claws serve to distinguish this species from other members of the great genus *Nymphon*. Examination of the nervous system shows that the two hinder ganglia are both situated in the third leg-bearing segment (fig. 9). The male with eggs attached to the oviger (fig. 1) has the fourth and fifth segments of that limb longer than in the other specimens (from one of which fig. 5 was drawn). Perhaps the latter are not quite adult. The egg-mass is elongate. A few of the eggs are hatched, the larva (fig. 7) being of the typical pycnogonid type with three pairs of appendages. The cheliforus has its cement-gland opening at the tip of a long sickle-shaped process. The succeeding limbs have no fringe of swimming-hairs; the terminal segment in each bears a prominent claw-like process.

The denticulate spines on the terminal segment of the oviger show an interesting transition from a very simple condition to a typical nymphonid deticulate spine, in which, however, there are only four sinuate prominences on each side besides the usual basal tooth.

Family **Pallénidæ.**

Pallenopsis, *Wilson.*

Pallenopsis Crosslandi, sp. nov. (Plate **27**. figs. 10–20.)

Female, length 8 mm. (including proboscis and abdomen).

Body broad, ovate, with lateral processes of segments close together; terga of 3rd and 4th leg-bearing segments fused. Head half the length of body

(without proboscis and abdomen) (figs. 10, 11). Proboscis elongate, swollen in middle. Abdomen elongate, spinose, nearly half as long as rest of body. Eye-eminence very prominent with blunt apex ; eyes small, hinder at higher level than forward pair (fig. 10). Chelifori with elongate slender scape showing a trace of jointing only (figs. 10, 11, 14); "hand" stout, beset with spines, "fingers" stout and strong with marked shearing edges (fig. 13). Palp vestigial, as usual in the genus (figs. 14, 15). Oviger eight-segmented (fig. 16). Legs with 2nd coxal segment three times as long as first (fig. 10); thigh with a few long denticulate spines and a blunt apical process (fig. 10); 1st tibial segment as long as thigh, beset with numerous denticulate spines, most of which are set on finger-like processes (figs. 10, 18); 2nd tibial segment one-fifth longer than first, with numerous slender spines and bristles; propodus with six strong basal spines, and very large accessory claws which almost equal the principal claw in length (fig. 20).

Habitat. Wasin Channel, coast of British East Africa, 10 fathoms, 1902. A single female. (Type in University Museum, Cambridge.)

This curious and beautiful pycnogon is perhaps the most interesting species of that remarkable genus *Pallenopsis* yet discovered. The broad form of the body and the partial fusion of the segments would lead to the inclusion of the species in the subgenus *Rigona*, recently proposed by Loman (1908, pp. 67–8) for some Malayan and Australian members of *Pallenopsis*. In those species, however, it is stated that the scape of the cheliforus is altogether unsegmented, while in *P. Crosslandi* there is a distinct trace of jointing. The oviger is apparently eight-segmented, owing to the fusion of the seventh and eighth and the ninth and tenth segments (fig. 16), a condition noticeable in other female *Pallenopsis*. In the legs the curious finger-like processes on the first tibial segment are especially noteworthy (fig. 18). These, and indeed the legs generally, are beset with the prominent openings of numerous cuticular glands, provided at the edge of the orifice with small sharp spines (fig. 19). The elongate spines on the thigh and the first tibial segment are highly denticulate (figs. 10, 18). Another noteworthy feature is the great length of the accessory claws (fig. 20), nearly equalling the principal claw. The variation of this character in the genus *Pallenopsis* is remarkable and instructive.

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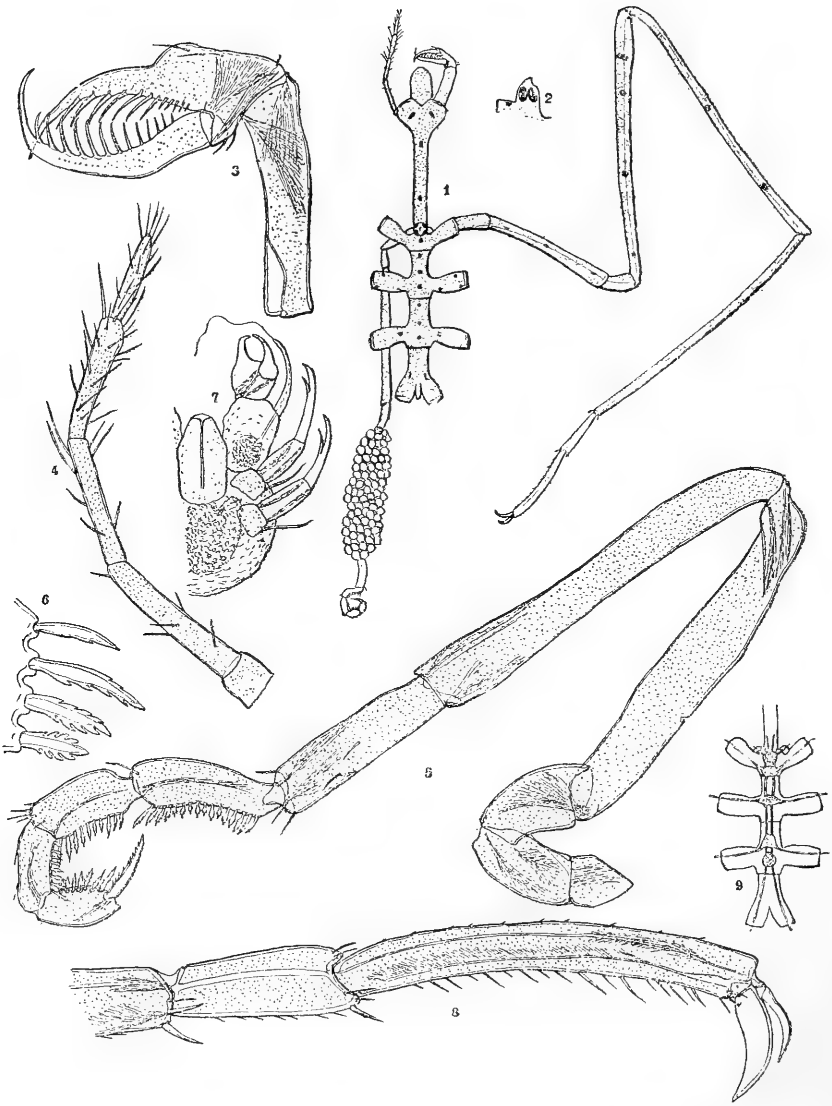
1908. J. C. C, Loman.—Die Pantopoden der Siboga Expedition. Leiden, 1908.



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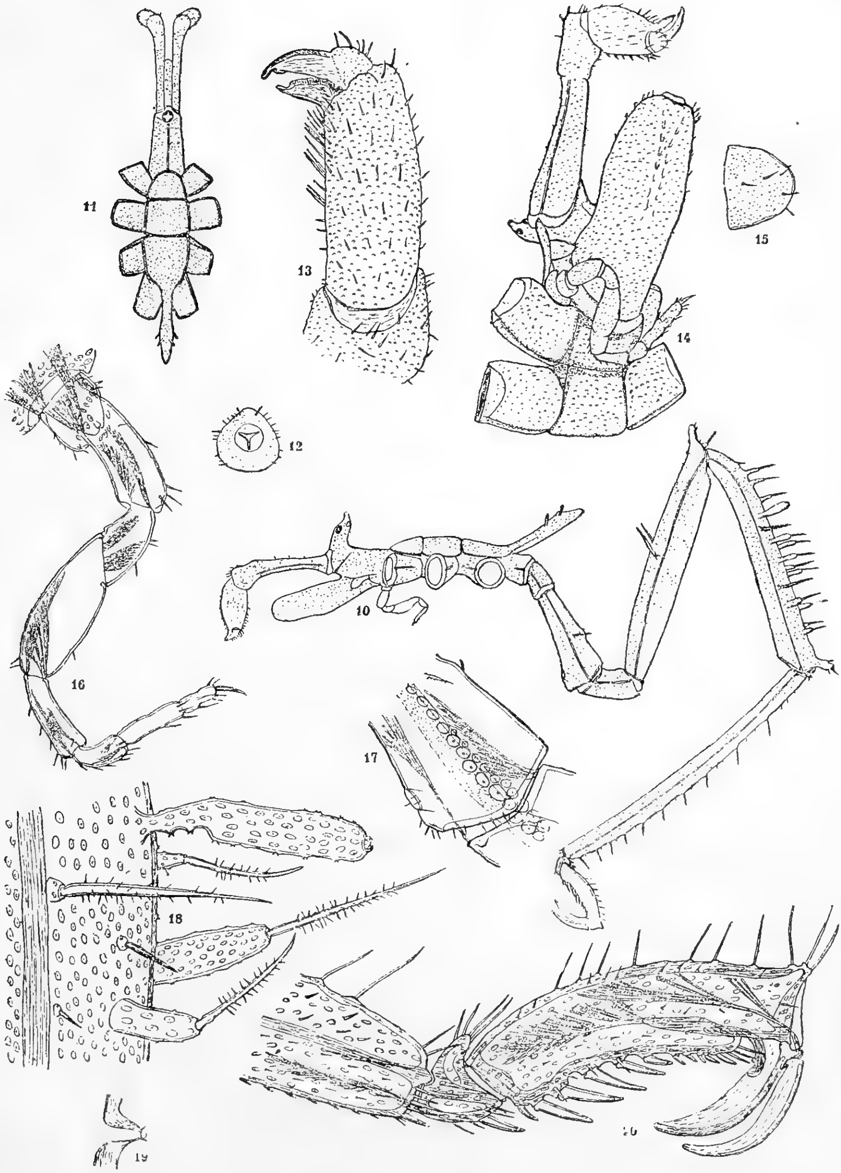
PYCNOGONIDA FROM THE RED SEA.



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PYCNOGONIDA FROM THE RED SEA.

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EXPLANATION OF THE PLATES.

Plate 26.

Fig. 1.	*Nymphon maculatum.*	Male, dorsal view, showing right cheliforus, left palp and oviger, and right 1st leg. × 8.
2.	" "	Eye-eminence, side view. × 13.
3.	" "	Cheliforus. × 40.
4.	" "	Palp. × 40.
5.	" "	Oviger. × 40.
6.	" "	Spines on 7th segment of oviger. × 220.
7.	" "	Newly-hatched larva, ventral view. × 100.
8.	" "	Tarsus and propodus of leg. × 33.
9.	" "	Ganglia and nerves of ventral chain. × 8.

Plate 27.

Fig. 10.	*Pallenopsis Crosslandi.*	Female, side view. × 5.
11.	" "	Dorsal view. × 5.
12.	" "	Tip of proboscis, end view showing mouth. × 10.
13.	" "	Terminal segments of cheliforus, end view. × 22.
14.	" "	Head with proboscis, left cheliforus, palp and oviger, and second leg-bearing segment; ventral oblique view. × 10.
15.	" "	Palp. × 25.
16.	" "	Oviger. × 25.
17.	" "	End of 2nd coxal segment of leg, showing gastric diverticulum, muscles, ovary, and oviduct. × 16.
18.	" "	Outer edge of thigh, showing tuberculate outgrowths, denticulate spines, and cuticular glands. × 40.
19.	" "	A cuticular gland. × 350.
20.	" "	Tarsus and propodus of leg. × 25.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA, from Collections made by CYRIL CROSSLAND, M.A., B.Sc., F.L.S.—XVII. The ANOMURA. By W. RIDDELL, M.A. (Communicated by Prof. W. A. HERDMAN, F.R.S., F.L.S.)

[Read 17th December, 1908.]

THIS collection of Red Sea Anomura contains 17 species, representing 12 genera. None of the forms are new, but one or two are of some interest. It includes the first recorded female of *Cestopagurus coutieri*, Bouv., and I have also been able to add something to Nobili's description of *Galathea humilis*, Nob.

I have to thank Prof. Herdman, in whose laboratory most of the work was done, both for entrusting this collection to me for examination and for his kind help in connection with literature, and in many other ways.

Family **Paguridæ**.

Genus PAGURISTES.

PAGURISTES JOUSSEAUMI, *Bouv.*

(Bouvier, **3**.)

This specimen is more or less intermediate between the varieties *glabra* and *intermedia*, being rather hairy but without well-developed spines. It belongs to this group, however, being distinguished from Nobili's variety *perspicax* (Nobili, **13**) by the eye-stalks.

Suez flats, 1 specimen.

Genus CLIBANARIUS.

CLIBANARIUS CARNIFEX, *Heller*.

(Heller, **9**; Bouvier, **3**; Nobili, **13**.)

Suakin Harbour, 3 specimens.

Genus CALCINUS.

CALCINUS LATENS (*Rand.*).

Pagurus latens, Randall, **13**.
Calcinus latens, Dana, **5**; Bouvier, **3**; Alcock, **1**; Nobili, **13**, **14**.
C. cristimanus, Heller, **9**; Paulson, **17**.

Engineer Island, Khor Dongola, 4 specimens; Mersa Arrikiya, 1 specimen.

Genus Pagurus.

Pagurus euopsis, *Dana*.

P. euopsis, Dana, **5**; Henderson, **10**; Alcock, **1**; Bouvier, **3**; Nobili, **13, 14.**
P. depressus, Heller, **9**; Kossmann, **11.**
Dardanus hellerii, Paulson, **17.**

Suakin Harbour, 2 specimens; Agig Bay, 1 specimen; Mersa Wadi Lehana, 1 specimen.

Pagurus tinctor (*Forsk.*).

Cancer tinctor, Forskål, **7.**
Pagurus varipes, Heller, **9**; Bouvier, **3**; Alcock, **1.**
P. tinctor, Nobili, **13, 14.**

I follow Nobili's authority in changing the specific name, as I have been able to refer to Forskål's description.

Suakin harbour, 3 specimens; Mersa Arrikiya, 1 specimen; Mersa Makdah, S. el Shubuk, 8 specimens.

Genus Eupagurus.

Eupagurus (?) cavicarpus, *Pauls.*

(Paulson, **17**; Nobili, **14.**)

These specimens are rather doubtfully assigned to Paulson's species, as I have not been able to refer to his original figures. They agree in many ways with his description as given in Nobili's translation, and come nearer to it than to any other species of *Eupagurus.*

Suez flats, 5 specimens.

Genus Cestopagurus.

Cestopagurus coutieri, *Bouv.*

(Bouvier, **4.**)

This species has not been recorded since 1897, when Bouvier created the genus and species for specimens from Djibouti. Alcock has described a second species from the Maldives.

Bouvier's specimens were all males. The present specimen is a female, bearing ova, with a carapace 3 mm. in length. It agrees fully with Bouvier's figures and description, except that the hair does not seem so pronounced.

Southern reef, Tella Tella Kebira, 1 specimen.

Genus Cœnobita.

Cœnobita rugosus, *Edw.*

(Milne-Edwards, **12**; Dana, **5**; Alcock, **1**.)

Tella Tella Kebira, 7 specimens.

Family **Galatheidæ**.

Genus Galathea.

Galathea ægyptiaca, *Pauls.*

(Paulson, **17**; Nobili, **14**.)

Off Beacon Island, Khor Dongola, 13 specimens.

Galathea humilis, *Nob.*

(Nobili, **14**.)

The specimens described by Nobili were all in bad condition, no ambulatory legs being present. The present specimens are also in poor condition, but one has got the ambulatory legs present. The characters of the rostrum and carapace agree closely with the description and figure given by Nobili. The chelipedes seem rather more spiny.

Ambulatory legs. The dactylopodite has four (or possibly even five) teeth inferiorly, the largest next the claw. The propodite has four long spines inferiorly, one being almost on the distal border. The coxopodite has no spines, the meropodite has two on the inferior surface.

Off Beacon Island, Khor Dongola, 3 specimens in bad condition.

Family **Porcellanidæ**.

Genus Petrolisthes.

Petrolisthes bosci, *Aud.*

(Heller, **9**; De Man, **6**; Ortmann, **15** *b*; Nobili, **13**.)

Tella Tella Kebira, 1 specimen, chelipeds missing.

Petrolisthes lamarcki, *Leach.*

A full synonymy of this species and its varieties will be found in Borradaile (**2**). He has pointed out that *P. dentatus* and *P. rufescens* are only varieties of *P. lamarcki.* Ortmann (**16**) and Nobili (**14**) have also shown that there is great variation in this group of forms. The present forms belong mainly to the *dentatus* variety, but the *rufescens* variety is also

represented. The epibranchial spine, as Ortmann has shown, is very variable. In two specimens, otherwise alike, the epibranchial spine was absent in one, present in the other.

Suez mud flats, 11 specimens; among coral, Suez, 29; Tella Tella Kebira, 10; Suez Bay, 5; no locality given, 1.

PETROLISTHES LEPTOCHELES, *Heller.*

(Heller, **9**; Nobili, **14**.)

Coral, Suez, 2 specimens; coral, Suakin, 1; Suez flats, 2; Tella Tella Kebira, 1; Khor Dongola, 4; no locality given, 2.

Genus POLYONYX.

POLYONYX DENTICULATUS, *Paulson.*

(Paulson, **17**; Nobili, **14**.)

Suakin Harbour, 3 specimens; Suez Bay, 6; Engineer's Island, Khor Dongola, 6; "Among sponges, Jan. 11th, 1905," 88; washings from "bottle 44," 1.

POLYONYX BIUNGUICULATUS, *Dana.*

(Dana, **5**.)

Beacon Island, Khor Dongola, 1 specimen.

Genus PACHYCHELES.

PACHYCHELES SCULPTUS, *Edw.*

(Milne-Edwards, **12**; De Man, **6**; Ortmann, **16**; Nobili, **13**.)

Tella Tella Kebira, 1 specimen.

Genus PORCELLANA.

PORCELLANA INÆQUALIS, *Heller.*

(Heller, **9**; Nobili, **13**, **14**.)

According to Heller, the right cheliped is the larger; according to Nobili, the right generally, sometimes the left. In the present specimens the right, on the whole, is most often the smaller. They may be subequal. Nobili says that in his specimens the median lobe of the front was broadly rounded, and that none of them corresponded to Heller's figure, which represents the lobe as acute. In the present specimens this lobe is usually more or less acute, not so acute as Heller figures it, but more so than Nobili shows it.

Reef flat, Engineer Island, Khor Dongola, 54 specimens; Tella Tella Kebira, 53; off Beacon Island, Khor Dongola, 42.

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Reports on the Marine Biology of the Sudanese Red Sea.—XVIII. A Physical Description of Khor Dongonab, Red Sea. By Cyril Crossland, M.A., B.Sc., F.L.S., F.Z.S., Marine Biologist, Sudan Government.

(Plates **28–34** and 3 Text-figures.)

A Supplement to the Author's "Recent History of the Coral Reefs of the Red Sea," in Journ. Linn. Soc., Zool. vol. xxxi. (1907) p. 14.

[Read 19th January, 1911.]

[Dongonab is the correct pronunciation of the place-name spelt Dongola on those few maps which insert it, and so spelt by me in my paper of 1907. Khor Dongonab is marked Dongonab Bay on the last Admiralty Chart published.

The Arabic word Khor is very loosely applied to almost any depression of the ground, great or small. Khor Dongonab is a bay 15 miles long by from 3 to 8 wide. Other Khors are inlets like Suakin harbour, a mile or more long by a few yards wide, or shallow watercourses on land which contain rushing torrents once or twice in a year, or deep ravines among the hills. The word has even been applied to an artificial trench 10 feet wide by 4 deep.]

In the paper to which parts of this may be regarded as a supplement I showed that the very peculiar structure of the Red Sea coasts * is due to certain earth-movements which were consequent upon the opening of the Great Rift Valley † of which the Red Sea is a portion. Briefly this structure is as follows :—

The Rift Valley.—The sides of the trough are represented by a chain of hills of Archean rocks, the summits of which are from four to eight thousand feet above sea-level. From their bases, where it is at a level of several hundred feet, there slopes down a plain of alluvium, which joins the band of coral-rock forming the coastline. At its highest this is an undercut cliff up to ten feet high, below which are fringing reefs, two miles to one-tenth of a mile in breadth, and seawards a deep channel two to five miles wide, and finally the barrier reefs (see Map 1, Pl. **28**). It was shown that this barrier system is founded upon a range of submerged hills similar to those low sandstone hills which now break the maritime plain, and which, like all the features enumerated, run more or less parallel with the Archean hills, the real sides of the Red Sea trough. These sandstone hills are, so far as

* My papers refer particularly to the coast between Rawaya and Suakin, but a slight acquaintance with the east coast about Jedda and the west side north of Rawaya to the Gulf of Suez, shows that the remarkable uniformity of the portion particularly examined is found generally in the northern part of the Red Sea.

† J. W. Gregory, 'The Great Rift Valley.'

they have been seen, capped with coral, and were once barrier reefs lying off a mountain coastline.

Geological History.—The history of the coast has been one of continual uplifting, the stages of which were as follows.

At the time of the opening of the Red Sea Rift Valley the Archean rocks were covered more or less with a sedimentary sandstone, and the gypsum now found associated with it was already formed. The faulting and minor adjustments consequent resulted in these sedimentary rocks being thrown into folds parallel to the sides of the main faults, of which folds three main systems are now conspicuous, lying at successively lower levels *. The sea now filled the valley up to the bases of the great hills, probably not for the first time, the highest of the sandstone folds being more or less submerged.

Fig. 1.

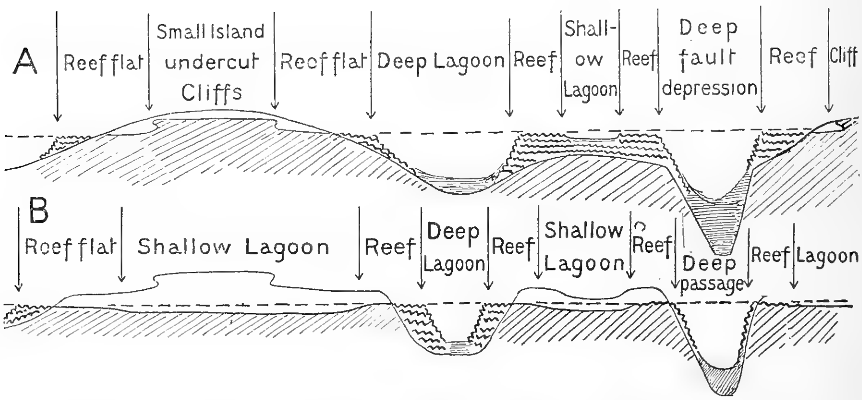


Diagram of the levelling of a range of partly submarine hills by erosion and coral growth, resulting in formation of a complex series of reefs and lagoons; sea-level shown by dashes.

A. Thin line outline of range of hills of which two summits are shown, one above and one below sea-level, and a deep fault cleft between the summit and the rise towards a third. From these are formed an island surrounded by undercut cliffs and broad reef-flats, two deep lagoons, a miniature atoll with shallow lagoon.

B. The same after elevation and further erosion and coral growth, starting from the results shown in A. We have the complete removal of the island, broad reef-flats and a lagoon occupying its site. The atoll ring is broader, but otherwise much as in A, while the deep lagoons become narrow passages and are slightly shallower.

By the growth of coral on those portions over which the depth of water was not too great, and the cutting down of the islands, they were converted into a chain of barrier reefs (fig. 1). Assuming that the relative levels of the

* Detailed soundings outside the barrier reefs might reveal several more—note, *e. g.*, in the middle of the sea how closely the 500-fathom line approaches the narrow central trough with depths of 1000 fathoms.

three folds have remained the same throughout these changes, the second and third folds were below the depths at which reef corals flourish, and were merely submerged banks.

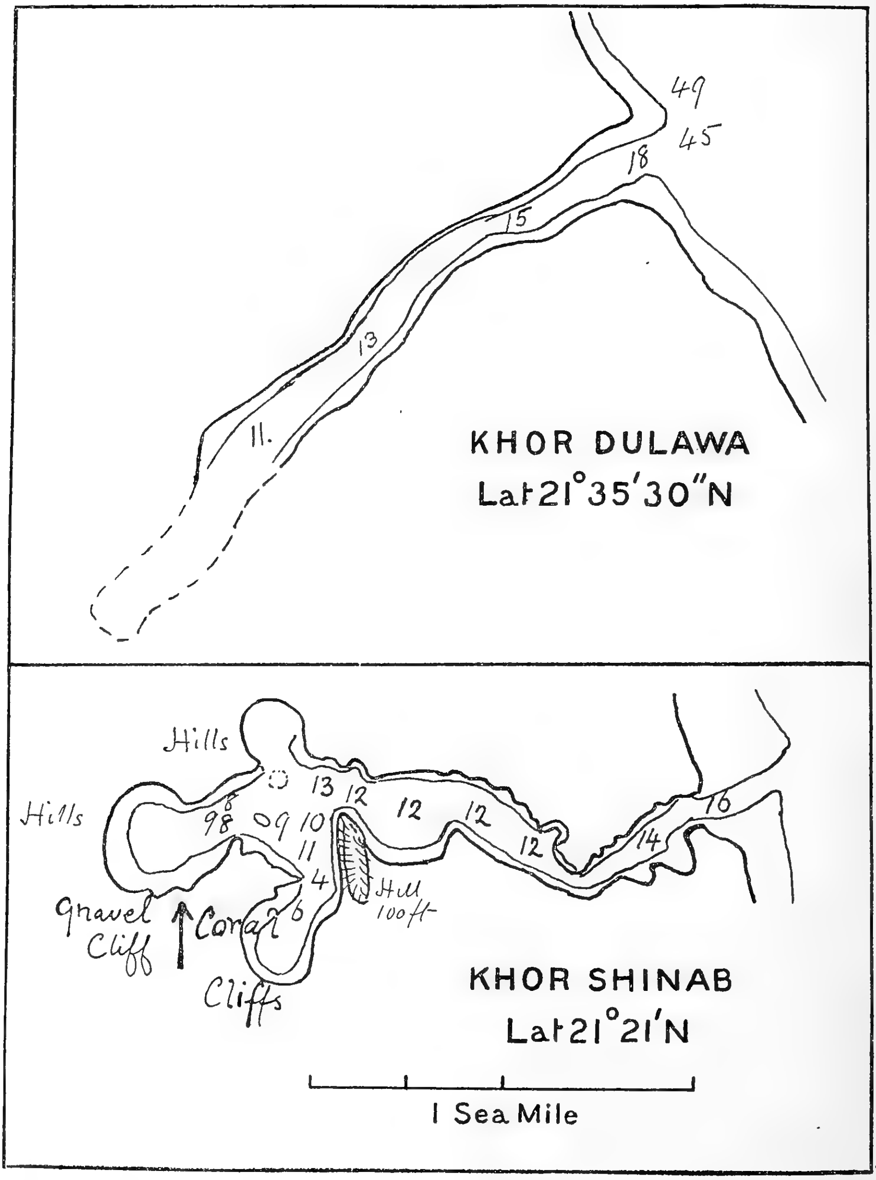
Successive uplifts of Coast-lands.—The formation of the maritime plain began at once, detritus from the hills tending to fill in the channel between the mountains and the barrier reefs. Elevation being in progress the barrier reefs began to emerge from the sea, and finally by the extension of the alluvial plain became islands of sandstone in a sea of gravel and sand. At the same time the depth was decreased over the submerged bank, which is the second fold, coral growths arose upon it, and this, with further uplifting, brought it to the surface and levelled it up as a nearly continuous second barrier system. The maritime plain, the formation of which was renewed by this uplift, still extended rapidly into the quiet water within this barrier, reached now its maximum modern seaward extension, generally nearly up to the barrier, sometimes throwing deposits of gravel over the growing reefs. Finally, another elevation converted the barrier into dry land, the present coastline, and the spaces left between it and the gravel plain were filled in with fine alluvium, making the present continuous maritime plain, a few spaces of water being left as the inner arms of harbours.

During this last uplift the third fold came within the range of coral life, and the northern portions of the submarine hill range emerged as the hills of Shadwan, Ras Benas, Rawaya, and the outer coral ridge of Ras Salak. Also the whole fold shifted seawards, so that portions which, like Rawaya, were once continuous with the maritime plain and received from it fragments of Archean rock from the high hills, are now separated from the mainland by four miles of sea.

The Harbours.—At this time also were formed those very remarkable features of this coast *, the landlocked harbours (fig. 2), referred to in my former paper. It is shown later that these harbours are the most recently made of all these structures, and their position on the summits of the present fringing and barrier reefs indicates that these are synclinal folds and that their uplifting was accompanied by increase of folding which was relieved by cracking along the summit of the syncline. The long deep pools, which may be miles long and several fathoms deep, on the flats of the fringing reefs have the same origin.

* The equally striking harbours of the raised coral coast of Equatorial East Africa—*e. g.*, Mombasa, Wasin, Tanga—were formed in the same way.

Fig. 2.



Plans of two of the canal-like harbours. Notice the considerable and nearly uniform depths, so unexpected, seeing that the surrounding land is only 6 to 10 feet above sea-level. The arrow in Khor Shinab indicates the junction of gravel with coral in the cliff which bounds the whole Khor.

Khor Dongonab. (See Map 1, Pl. **28.**)

In my description of the Barrier Reefs of the west side of the Red Sea I showed how Khor Dongonab gives the key by which the formation of the whole system may be understood. I have since lived in that neighbourhood for several years and have noted details which further illustrate the theory I formed in 1905, or which are of interest in themselves.

Khor Dongonab is one of the few large bays of a coast remarkable for the straightness of its outline. After the bays behind Shadwan and the other islands at the entrance to the Gulf of Suez, there are no prominent points until Ras * Benas, 540 miles down the coast, is reached, and then again none until Ras Rawaya, the peninsula which encloses Khor Dongonab. Further south again Ras Shalak and Trinkitat are the only protuberances, and not prominent ones, before Masawa is reached, more than a thousand miles from Suez.

Peninsula of Rawaya.—Rawaya is a low, slightly undulating surface of recent coral limestone, its yellow colour not at all veiled by the grey desert vegetation which occurs in a few shallow depressions. There are two higher areas, the plateau of Jebel Têtawib in the north, and Jebel Abu Shagara in the south, which are 80 and 127 feet high respectively, the latter hill being of inconsiderable area. (See Map 2, Pl. **29**, & Pl. **32.**)

There is no chart from which I can give the shape of the peninsula on its western side, the map in Pl. **29** may be taken as a very rough approximation. The area here is broken up by a complicated series of canal-like inlets of the sea of which a few are indicated, the depth of which is great in proportion to the height of the surrounding country, canals 60 feet deep cutting through land 6 feet or less above sea-level (Pl. **32.** fig. 1). This intricate canal system is, however, soon seen to follow a definite plan, being reducible to a series of longer canals more or less parallel to one another with shorter connecting branches at right angles. They are simply a more than usually numerous collection of those fault channels of which the harbours of the mainland are conspicuous examples. There are in addition a number of these miniature rift valleys which do not contain water, one of which is particularly striking, being a deep gash extending from the summit of Jebel Abu Shagara to the sea-level southwards. That this is not a deep stream-cut ravine is obvious from its position, there being no catchment area from which a stream could originate, and from its parallelism with the sheer cliff which bounds the hill on the east and which is obviously a fault.

Jebel Têtawib also ends in a cliff eastwards, and in both these cases a sea-water canal runs parallel with their bases separated from the cliff by an

* Ras, Arabic = Head = Cape.

area of sand scarcely raised above sea-level, cliffs and canals being the result of one earth movement.

Bird's-eye View of Rawaya.—The view from the summit of Jebel Abu Shagara is beautiful and interesting in itself, and includes most of the features we are specially concerned with. Westwards is Khor Dongonab, here 8 miles wide, and beyond it the alluvial plain, which, throughout the length of this coast, separates the coral shore-line from the Archean hills. These rise majestically to the height of 8000 feet, the range continuing north and south with summits from four to six thousand feet. Ten miles southwards are the yellow islands of Makawar * and Mayitib, parts of which are faulted up to heights of 300 and 138 feet, while parts remain at about the same low level as Rawaya. The high ground occupies two-thirds the area of Makawar, while Mayitib is now separated into two, a pyramidal hill and a low flat island only six feet high, on the same reef flat.

Between us and the islands is a maze of coral reefs, white lines of breakers bounding calm lagoons, separating the blue-black of the open sea from the greens and browns of the sheltered beds of living coral and shell sand.

Rawaya, Makawar, and the reefs between are all one hill-range, part of which is just submerged, and which is continued still further south as the ordinary barrier reefs which fringe the rest of the coast.

We stand between the dry ravine which almost cleaves the hill into two (Pl. **32**. fig. 3) and the cliff which forms its eastern side. Below the cliff is the bifurcated end of a canal eight miles long from its communication with Khor Dongonab, and a completely enclosed lake of salt water separated from the sea by reefs over which perhaps one might drag a canoe at times of high water. Judging from its colour I estimated its depth at 30 feet, and like all these canals the shores are low cliffs descending abruptly into nearly the full depth of the pool. In shape and position this is obviously a section of one of the ends of the long canal above mentioned which has been isolated by the imperfect continuity of the fault which formed them and the cliff on which we stand. Beyond these canals and lake the ground is rather higher than usual in Rawaya, broken up into troughs similar to the canals but for being smaller and not deep enough to contain water.

Northwards we overlook the plain of yellow coral broken by brilliant blue sea-water inlets and lakes as far as Jebel Têtawib, nine miles away, noting particularly the long parallel-sided tongue of land, named Haysoit, separating the main canal from Khor Dongonab.

Three miles to the north-east are the buildings of the Rawaya Salt

* This is the Arabic name and means "broken" or "hollowed," referring perhaps to its precipitous eastern side or to its division longitudinally by a fault-valley. Its native or Hamitic name is Meqursam.

Company, now abandoned, rising white and imposing, strangely alone in the midst of this yellow desert. Between us and them is the salt lake, acres of wet salt, like a frozen sea, which was their *raison d'être*, yet another of these fault depressions, in this case completely shut away from the sea. (Pl. **32**. fig. 2.)

Formation of the Barrier Reefs.—As noted in my former paper, the barrier reefs are a series of large areas covered with an intricate network of reefs and shoals with comparatively deep lagoons between. We see from our examination of Rawaya how many of these deeper passages have arisen. Imagine Rawaya at a level say ten feet lower. The greater part of the land remaining above water would then be quickly cut down to form reef flats, the two hills remaining as islands, the canals as lagoons and passages between the reefs. Another series of lagoons would be formed by the solution and degradation of the reef flats, the outer edges of which are protected by growing corals and remain as long and narrow surface reefs, generally crescentic or incompletely circular in form. This is obviously the origin of the reef maze lying between Rawaya and Makawar, and, by inference, of the rest of the barrier system. (See fig. 1, p. 266.)

In my previous paper it was stated that there were no hills at Salak (Maps 1 and 3) to make a complete correspondence between Ras Salak and the barrier reefs extending southwards from it, and Rawaya and its reefs. Since then I have had opportunities of seeing more of that neighbourhood, and I find that there is a line of raised coral running along the coast for about ten miles, which, though only ten to twenty feet above sea-level, is very distinctly marked off by a broad flat salt marsh separating it from other raised coral westwards. This latter is continuous with the shore reefs about the harbour of Little Salak, so that we have, on land, elevated continuations of both systems of reef, separated by a wide valley of fine alluvium formed by the filling in of the lagoon between the reefs. The sketch-map (Pl. **30**) makes the arrangement clearer.

The shore of this salt marsh is obviously extending seawards, probably under the influence of sandstorms as much as, or more than, of rain floods. The correspondence of Ras Salak with Ras Rawaya and of the salt marsh with Khor Dongonab is thus complete, the former being on a smaller scale.

The origin of the Ship Channel.—The size of this channel between the fringing and barrier reefs is very considerable, its average width being from 2 to 4 miles and depth from 15 to 200 fathoms. (Map 1, Pl. **28**.) There is nothing to hinder large steamers travelling up it from Suakin to Mohamed Gûl, and of course that section lying between Port Sudan and Suakin is so used. The traveller by native boats of 20 to 50 tons sees the

reefs at rare intervals, their presence or absence being only inferred through the direction and size of the waves met with.

Khor Dongonab again gives the clue to the formation of this channel. Although Rawaya is formed entirely of coral, gypsum and sandstone, in the way I described in 1905, a few fragments of black stone from the Archean hills of the mainland are to be found at intervals on the surface of the coral, and though these are so few as to occur singly they are too numerous to have been brought over by human agency, and are conclusive proof that Rawaya was once continuous with the maritime plain of the mainland. Khor Dongonab therefore is a very recent fault depression; Rawaya, and with it the whole barrier system, having been torn away from the mainland, leaving a rift which the sea has filled.

Age of the Maritime Plain.—The ages of these pebbles from the Archean hills to the coral formations are of great interest as indications of the relative ages of the maritime plain, the reef and the earth movements which have made the peculiar features of the present coastline. It must be remembered that the corals and shells which compose these limestones are all identical with living forms. As a general rule the band of raised coral which now forms the coastline is at a somewhat higher level than the strip of finer alluvium which separates it from the gravel of the main mass of the plain. The arrangement is, indeed, like that described at Ras Shalak, but on a much smaller scale. Where, however, gravel and coral meet, the former overlies the latter. The most striking case is found in the cliffs of the innermost branch of Khor Shinab (see plan, fig. 2 on p. 268, and Map 1, Pl. **28**), where coral cliff passes into gravel without the least change in the outline of the Khor, and even without alteration of the shape of the cliff other than that due to the insolubility of the gravel. Nothing could more strikingly show that both alluvial plain and coral reefs were fully formed before the earth movements occurred which formed the present features of the coast, and that these affected both formations equally whenever both occurred within the sphere of their action. It proves also that the rest of the maritime plain was fully formed at that time, its later extension seawards having been insignificant, whatever may have been added to its landward slopes. Not only so, but the existence of beds of pebbles, a few feet or a few inches thick, *below* the coral in the ravine of Jebel Abu Shagara carries back the history of the maritime plain much further. They indicate the existence of a maritime plain and earth movements, which, compared with those which we are considering, are of a very old date, though in geological time still recent.

A portion of this older maritime plain has become isolated, and so preserved distinct, as a low hill about 100 feet high two miles south of Dongonab village, and its continuation northwards as a gravel ridge 10 to

20 feet above sea-level. These are now separated from the rest of the same formation by a broad flat valley, very slightly raised above the sea and opening into a bay on the west side of Khor Dongonab (see Map 2, Pl. **29**). It is exactly comparable to the valley at Salak, or to Khor Dongonab itself, in origin and topography, the gravel being substituted for raised coral. The old character of the hill is shown not only by its present isolation from the rest of the gravel plain, but by the existence of the strata in which the gravel is bound together by gypsum, these more coherent strata protecting the mass of loose gravel below them and forming steep-sided butts.

The wells which supply Dongonab village and the nomads' flocks are sunk in this flat valley bottom, about a mile from the sea. As might be expected, the water obtained is too salt to be used by any but natives ; the wells, though only ten feet deep, reaching sea-level. For the first few feet they pass through yellow blown sand, which suddenly becomes blue in colour and of a clayey consistence, the change indicating a former sea-level 6 feet or so above the present one, as will be shown later. Near the level at which the influx of water stopped our digging, some decayed wood was brought up with a species of *Ostrea* attached and other marine shells with them.

We have thus additional proof, if that were needed, of the origin of these valley-flats by the filling in of bays, principally by blown sand.

The Gypsum Deposits.—Gypsum is abundant in many places along the coast, among the sandstone hills, which are generally a few miles inland. I figured its contorted strata underlying the horizontal coral of Jebel Têtawib in 1907, and Pl. **32**. fig. 3 shows it, less clearly, in the ravine of Jebel Abu Shagara. Its unconformity with the coral in Jebel Têtawib proves its formation prior to the present sides of the Red Sea trough.

Theories of Formation.—Gypsum, calcium sulphate, might be formed either by conversion of limestone, calcium carbonate, by the action of sulphurous geyser springs, or the life activities of sulphur bacteria, the product being afterwards oxidised. These origins would seem feasible in view of its juxtaposition to coral-reef limestones, but, as we have seen, this implies no other relation, the strata being unconformable. Further, the action of volcanic gases or springs, or of sulphur bacteria, would probably not be perfect throughout the mass of rock, but in the one case would result in local metamorphoses, gypsum passing into unaltered limestone on either hand, or, in the second case, of alteration of the upper strata, the lower being mixed carbonate and sulphate, or of carbonate alone. There is no visible trace of such local action anywhere, and samples of every part of the Jebel Têtawib deposit have been analysed * and found to be very pure sulphate.

* By Dr. Beam, of the Wellcome Research Laboratories, Khartûm. See Wellcome Laboratories Annual Report, 1908.

The very wide distribution of the deposits among these hills, even as far north as Kossêr (lat. 26° N.), postulates an agent the range of which was coterminous with the ancient Red Sea, such as, for instance, the evaporation of its salt water. The Bab el Mandeb Straits, between the Red Sea and Indian Ocean, are not only very narrow but show signs of comparatively recent volcanic action, so it is not at all difficult to imagine their becoming blocked and again opened, possibly more than once, before those final movements which we have considered. If we are right in attributing the faulting up of the barrier reefs to the actual opening of the Rift Valley, it is probable that at the time the gypsum was deposited the area was occupied by a much shallower sea, in which the deposition of gypsum by evaporation would readily take place.

The Rawaya Salt Field.—I am the more inclined to this theory by my acquaintance with the Rawaya Salt Field, where a bed of gypsum is in actual process of formation. This lake of salt (Pl. **32**. fig. 2) is a fault-depression shut off from the sea except by subterranean leakage on the south side. During the winter sea-water enters this way and so renews the supply, but in summer the sea-level is slightly lower and scorching winds remove this, leaving the surface firm, dry salt. Beneath the salt, at a depth of two or three feet, the deposit changes into a mass of loose, white crystals of gypsum, the formation of which is evidently recent and still continuing, a fresh supply being deposited from the sea-water added during each winter. How deep the gypsum may extend I do not know, but if this depression is as deep as the adjacent ones, there may be thirty to sixty feet of recent gypsum to the three feet of salt.

Dongonab Plain.

The west shore of Dongonab Bay from the point marked by an arrow (on Map 2, Pl. **29**) to its head, a distance of about 10 miles, is favoured over the whole Sudan coast of the Red Sea in that it is formed of sand beaches sloping quickly into water two to three fathoms deep. At about half a mile from the shore lie coral-reefs and shoals, which will be described later, enclosing a series of harbours, shallow as stated, but unobstructed by coral, quite ideal for the small craft which alone navigate this coast. Dongonab Harbour is that one of the series which has but moderately complicated entrances, one of the best beaches, and is nearest to the well.

The shore itself is extremely low, about three feet above mean water-level, in winter often only one foot above the sea. For from a quarter to half a mile inland its surface is of sand alone, perfectly level but for hillocks of loose sand where vegetation occurs. Further inland is the gravel ridge mentioned on page 270, which runs northwards from Dongonab Hill and separates the valley in which are the wells from the sand plain. The mass of this ridge is

mostly sand, as is the maritime plain, the surface of the deposit containing an undue proportion of stones owing to removal of loose sand by the wind.

The sides of this gravel ridge were once the sea-shore, the sand plain, like the well valley, being of marine origin as evidenced by numerous marks of old beach lines running more or less parallel to the curves of the present shore line, and, in one or two places, by outcrops of coral. Numerous modern sea-shells strew the surface, *Murex ramosus* and *Strombus* sp. being the most common, while, by digging, many smaller and more delicate species are turned up, the proof of the marine origin of the ground, not only its surface, being thus complete.

Detailed Description.—The plain has several peculiar features which make its description, and the explanation of its formation, worthy of attention. Along its seaward edge is a band of sand hillocks one to three feet high formed by the collection of blown sand among and to leeward of tufts of the Halophyte *Suaeda Volkensii* * (see Pl. **30**). This wonderful plant is able to preserve a touch of brilliant perennial green in these fearful wastes, where there has been practically no rain for four years, and in autumn is still splendid with the crimson bracts of its flower-spikes. Its succulent leaves remain fresh, notwithstanding the storms of summer which dry all moisture from ordinary vegetation like the heat of a fire and which dull glass by the rasping of the driven sand grains. Within this zone, which is about ten yards wide, the surface is almost perfectly bare and level. There is no loose sand, and though at first the surface is soft like soil, or hard and friable as though frozen according as the weather is damp or dry, a little distance inland it becomes nearly as hard as a macadamised road. There are areas of exceptional hardness, where the surface is more like stone than sand, and can only be broken by chisel or crowbar. These are generally found in bands which more or less follow the curves of the shore line, and represent the tops of ancient beach lines. They are chosen by the natives as sites for their houses, providing clean hard floors ; one area was so perfectly smooth and large as to provide us with an excellent tennis court. The third and innermost section is nearly as broad as the second, and here the general level is raised and the surface made undulating by the collection of dry sand by two species of salt-loving desert grasses—an outer band of *Æluropus villosus*, recognised by its grey prickly leaves, almost like furze prickles, and especially by its globular white flower-heads on slender stalks; an inner band of another prickly grass which is, however, more of the ordinary gramineous form. Both propagate by

* *Suaeda* generally occurs alone, but in places other Xerohalophytes occur. The latter are species very abundant as a fringe round the high-water line of all the sandy islets where *Suaeda* is very rare or quite absent. These islets are formed of broken shell and coral, the plain of inorganic sand.

creeping stems which root at the nodes, may be six feet long, and which must increase their effectiveness as sand collectors. Specially conspicuous accumulations are sometimes made by *Æluropus*, e. g. near Dabadib Harbour, where a considerable area is covered with conical hillocks of fine red dust resembling termites' nests, four or more feet high, which have been accumulated in continuously growing tufts of this grass. The *Æluropus* grass is accompanied by another succulent Xerophyte, which is also found among the acacia bushes (*Acacia tortilis* with *Lycium persicum*) of the gravel, but the grasses are there absent. A very little of the ordinary woody grass of the maritime plain is present among the bushes, which, in contrast to the halophilous grasses above mentioned, is leafless all the summer, indeed it has now been practically so for four years. Beyond the gravel area the head of the well valley is blocked with sand-hills of considerable size, mostly quite bare, but in places covered with bushes up to six feet high, in shape and size strikingly recalling the British juniper, with dark green succulent and cylindrical leaves, and known to the natives as "asal" or "adlîb." Of these plants the *Acacia tortilis*, having for all its meagre height a well-formed trunk, and the grass of the gravel ridge are not sand collectors *. The "asal," one would think, should act in this way, but it certainly has done nothing towards forming the sand-hills near and on which it is found, even if it has possibly raised the general level of the valley bottom. It is not found on the largest sand-hills, and one often meets with cases where a thicket has died *in consequence* of the removal of the sand, not the dune's destruction, following the death of the bush. The xerophyte of the innermost section of the sand plain is, like the grasses, an efficient collector, but it occurs too sparsely on the gravel to have much effect. Indeed the action of the wind must be continually to reduce the height of the gravel while raising that of the inner side of the plain, and this latter area is extending over the bare part of the plain as fast as the reduction of the amount of salt in the sand will allow the grass to grow over it.

Excavation emphasises the peculiar coherence of the sand noted above, and the striking difference in colour as well as other properties between it and the fresh sand-drifts. The latter appear by contrast almost white, after a sandstorm its accumulations remind one forcibly of snow-drifts. On the trench meeting one of the harder bands above mentioned, crowbars and hammers are called for and the sand is removed as lumps of soft stone, not by spadefuls. One notices that these bands are formed of a very coarse sand, the grains of which may be up to a millimetre in diameter.

At a depth of two or three feet the sea-level is reached †, and the sand abruptly changes in colour from dull buff to a blue-grey. It ceases to be

* Another species of *Acacia* (native name Sanganeb) is present, but rare, which forms large hillocks, nearly as big as the bush itself.

† Compare the depth in the well valley at which this change occurred.

consolidated, but is sticky like clay, and full of the delicate shells of sand-loving lamellibranchs, being in all respects like the sand at the bottom of the harbour. Examination shows at once that the great bulk of this sand is inorganic like the sand-drifts, the difference in colour being due to admixture of organic matter, *e. g.* calcareous sand from the shells which have inhabited it, traces of carbonaceous remains of the bodies of lamellibranchs and worms or of the two marine phanerogams which abound in all these lagoons. It must be considerably affected by its passage through the intestines of holothurians, a large burrowing form of which is so abundant that its great conical casts cover the whole bottom. The clayey consistence is easily accounted for by the fact that the wind carries sand of all degrees of fineness, and that in these lagoons, which are almost tideless and perfectly sheltered, the very finest dust remains near shore instead of being cleaned out from the coarser sand and carried out to deeper water. In a shallow excavation this impalpable dust colours the water which collects to just that shade of red-brown which is so characteristic of the Nile flood, and it is probably nearly of the same composition as that valued fertiliser *. With great difficulty we carried our excavation to a depth of 12 feet, the character of the clayey sand remaining the same throughout.

We made one interesting find, viz., the bones of a dugong. These, though well preserved and hard, were found in small pieces only an inch or two long, and could only be identified by the presence among them of the tusks. The fact of so many fragments being found close together suggests that the bones had been carefully broken up for cooking, and human agency is corroborated by the presence with them of fragments of pottery. It is very probable that they were thrown overboard from a sambuk of the olden days anchored at this spot, now a hundred yards inland. Other evidence of the presence of man in times centuries past is afforded by the heaps of pearl-shells found by digging almost anywhere in the plain up to 100 yards inland at least (I have not excavated further), and the larger heaps on some of the islands. These, now brittle and of an opaque dull yellow colour with age, are obviously relics of the time when mother-of-pearl was of no value, and the fishery was followed for the sake of the pearls alone †. Their presence indicates that the beach was very near at hand at the time they were opened and thrown away, there being no inducement to carry them inland.

Climate.—The climate is at times the most disagreeable in the world, at times most delightful, but the formation of the plain is only due to the former conditions.

During the summer are intervals lasting three to ten days each, and

* Floods from the hills have the same colour, and so fine is the mud that after a flood Port Sudan Harbour remains red for days.

† Nowadays the fishery is for the shell, or mother-of-pearl, the pearls found adding only a percentage to the profits.

amounting in all to perhaps two months of the year, of the weather called by the natives "hurûr." The morning opens with a very light land breeze which soon dies away to a dead calm. It is hot half an hour after sunrise, and becomes unbearably so by 8 A.M., at which time the temperature approaches 100° F. Then comes the wind off land, a few premonitory puffs and in half an hour a gale carrying sand and dust, heated as if by fire, the temperature rising to 105° F., to 110° F. or even 115° F. The air is often so thick with sand that one cannot see 100 yards; nose, ears and eyes are filled, and teeth coated, with dust, and heaps of sand, like snow-drifts, accumulate to windward of any obstruction. For instance, a storm buried a pile of boxes in my store to such an extent that it took three men four days to dig them out and much more labour still to re-level the store yard. After a fence of roofing zinc was put up to prevent a repetition of this, another storm accumulated drifts on its windward side which I estimate at several tons of sand to each linear yard of fencing. The general level of the ground round my buildings and fences has been raised six inches to a foot in about two years. This wind generally blows till shortly before noon, but may continue till 4 P.M. In the former case it ceases suddenly, there is a dead calm for half an hour or so, the temperature drops to 90° F., and a sudden strong damp wind blows in from the sea, the dampness almost neutralising the fall of temperature so far as one's sensation of heat is concerned.

Sometimes this return wind comes in during the morning, the time that "hurûr" usually blows, the inference drawn by the natives, and I think rightly, being that the westerly hot wind is then blowing at a point further down the coast. The winds are apparently small cyclones, which are very local and do not extend far to sea. I remember once, while exploring a part of the barrier system about five miles from land, my schooner was picking its way among the reefs with the lightest of breezes, while shorewards some native sambûks were flying before a gale, and a vast cloud of sand blotted out the mountains from view. It would be very interesting to know what is happening at the bases of the mountains and in the upper air at these times.

These conditions obtain much more frequently at Port Sudan and Suakin, though the wind does not so often carry sand. North of Dongonab they are less frequent, being, according to the natives, absent altogether only a hundred miles away.

We have thus alternations of extreme dry heat and of dampness on one day. Exceedingly damp weather is the characteristic of the late summer and autumn, and of intervals of a few days at a time during the winter. Such weather is nearly as uncomfortable as extreme heat, even the natives become listless and depressed by it. The dews are very heavy, one's bedding, if left uncovered on the roof (the only sleeping-place during these sultry nights), becomes soaking wet, and water literally runs from clothing that has once

been wetted by the sea. In the morning the dew drips from the roof like rain. The winter is generally dry and pleasant, but there are intervals of strong damp south-east winds, which carry salt moisture over everything near the sea, and other manifestations of dampness are as unpleasant as described for the late summer.

Cementation of the Sand.—Now for the effect of these alternations of extremes upon the sand of the plain. The new drift is of a pleasant light yellow colour, dry and loose like the sand above high-tide mark of an English beach. In a few days it becomes darker coloured at the base, and finally this tinge spreads over the whole except perhaps the uppermost part, and the sand grains begin to cohere slightly. During a spell of damp weather the drift has drawn up moisture by capillary action from the damp plain, and with it salt *. Dry weather following, this water is evaporated, to be replaced by more drawn up from the plain (ultimately from the sea), so that in time a considerable quantity of salt is mixed with the sand. Rain removes the more soluble, leaving the less soluble constituents of sea-salt as a cement, which, in the case of the coarser deposits, converts loose sand into stone. The level of the plain is thus that at which capillary action can deposit enough binding material to counteract the abrasion of the wind and the sand it carries. Near the sea the level is temporarily raised a little above this by the dunes collected by *Suaeda*, but within this band, the vegetation being killed off by the consolidation of the sand, the hillocks are swept away and the level reduced so that the hard almost perfectly level surface above described is produced.

After every storm sand is deposited on the slope of the beach, thus extending the plain a minute distance seawards. This process would go on if no vegetation were present, but the *Suaeda* assists greatly by the increase of height it gives to the slope and by holding the sand together while the cementing process is begun.

The longest axes of these hillocks are, as has been noticed in other sand formations, not in the direction of the prevailing winds, fairly strong though these are, but in the direction of the sand-bearing gales, *i. e.*, not N.E. to S.W., but N.N.W. or W. to S.S.E. or E.

Coral Reefs.—In places patches of coral reef appear in the sand, but as these project only a few inches above the surface it is evident that they were cut down to sea-level after the first main movement of elevation in these reefs, attaining their present position by one of the minor ones which followed it, as described in my paper of 1907. They were then surrounded by the sand before the sea totally removed them. The neighbouring reefs which bound the lagoons seawards are almost certainly of the same age, but though areas

* Fine salt spray is blown on to the plain during high winds, but the darkening of drifts *from the base upwards* is evidence of the importance of capillary action.

of older rock occur at a slightly higher level than that of the living coral, no fragment now rises above the mean sea-level, even on the inner protected reefs or near the present shore. The inference is that the patches of coral in the sand of the plain were protected from erosion by the sea soon after their final elevation, while others only a little farther seawards were exposed so long as to be eroded to present sea-level. This, however, does not justify any belief in a slowing of the formation of the plain in recent times, as these patches are on the landward ends of reefs the shallow flats of which were soon covered by sand and form the long promontories which divide the lagoons from one another. Indeed these, like other features of the plain—*e. g.* the old beach lines,—indicate that its formation has been almost perfectly regular, and probably began after the reefs had reached their present condition. Without the shelter of the reefs the constitution of the sand described above could not have been as it is.

Dongonab Harbour Reefs.—These reefs are somewhat complicated, and only after having lived at Dongonab for some months was I able to pass the harbour entrances without the assistance of a native. But once understood, the plan of the reefs off Dongonab Harbour is very simple. They lie in three lines, the first being a nearly continuous surface-reef, the next a line of shoals with heads and patches of coral reaching to the surface, the third a series of rather deeper shoals with two fathoms of water generally, with rare heads reaching to a fathom of the surface.

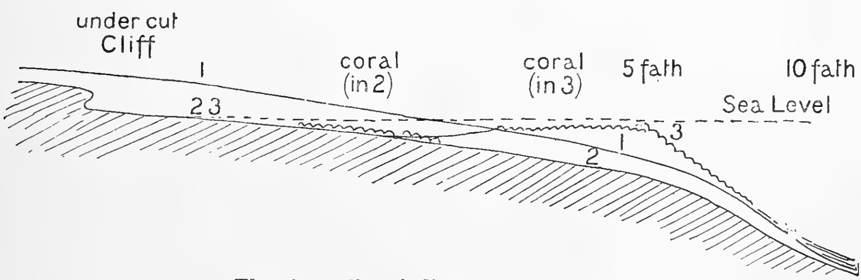
A good deal of mud and grey sand has collected about these reefs, so that when I saw them in 1905 I thought it possible that they were a series of banks of sediment with coral caps, a possible method of reef formation suggested by Darwin, and one which is the most probable explanation of the Shubuk reef labyrinth. There are, however, areas of old rock a few inches above the level at which growing coral covers the reefs, and this fact indicates that this series, like all the other reefs of the coast, owes its formation to faulting, three troughs separating the ridges which are now reefs. The fact that the outer ridges have not become surface-reefs is particularly interesting in connection with the ecology of coral, and will be referred to later.

Jedda.—It would hardly be worth while considering the formation of the harbour of a totally insignificant place like the village of Dongonab were it not that it is a miniature of the harbour of Jedda, just opposite on the Arabian Coast. Though quite unvisited by the ordinary traveller, this, the gateway of the Moslem Holy Land, is crowded with ships of all sorts, from large steamers to Arab sambûks, during the season of the Mecca pilgrimage. The very peculiar arrangements of the reefs which give it protection from the sea is evident by a glance at the plan on Pl. **31**.

Ecology of Coral.—In the Red Sea from the entrance to the Gulf of Suez southwards to Shubuk *, *i. e.*, from latitude 28° N. to 18° 40′ N., coral flourishes exceedingly on every reef; even within the canal-like harbours certain species survive in the muddy water near their heads. But there is a curious restriction of coral growth within Khor Dongonab; between Sararat Island in the south and Umm Tarda in the north the reef flats ending in walls of luxuriant coral (such as are universal everywhere) give place to sloping banks covered with stones and weed or sponges of the genus *Phyllospongia*. It is only after some residence and travel on this coast that the phenomenal nature of these conditions, normal elsewhere, is fully felt. There is nothing like it elsewhere on the Sudan Coast, and I should not be surprised to find that Khor Dongonab is altogether unique in this respect.

This reduction of coral growth becomes all the more puzzling when one finds that in certain places many species flourish perfectly †, and above all that in the northern basin of the Khor, above Umm Tarda, the normal Red Sea conditions are met with again. The shoals of this basin have been converted into level surface-reefs with precipitous sides, and the islands are surrounded by coral in the same way. But in the main basin of the Khor coral growth, in any quantity, is restricted to water two or three feet deep, and then is far from forming a complete reef-flat.

Fig. 3.



The zigzag lines indicate masses of coral.

Diagram of the results of marine erosion on a bank of elevated coral according as the growth of coral does or does not preponderate over forces of degradation. The shaded area, bounded by the line marked 2, is a section of a bank such as is characteristic of the Main Basin of Khor Dongonab; 1 is the outline of the original bank, and 3 that of the resulting reef when coral growth and denudation work together.

The slope of the sea-bottom round any of the islets or along the limestone shore of the west side follows one rule which is illustrated by the diagram of fig. 3. At a distance of two or three hundred yards from shore the gradual

* The southernmost point of which I have personal knowledge.

† Professor J. Stanley Gardiner is describing a collection mainly from Dongonab Harbour with his own collections from the Indian Ocean.

slope suddenly changes, soundings passing from five to nine or ten fathoms in a few yards. This suggests that we have come upon the lower portion of the usual reef precipice, and this is very nearly the case.

The diagram illustrates roughly the results of marine denudation upon a mass of limestone or sandstone in the presence or absence of vigorous coral growth, the line marked 1 being the outline of the mass as it was originally elevated; 3, after wave-erosion under the protection of growing coral, resulting in the formation of a reef flat, slightly hollowed out near shore and typical precipitous edge of growing coral; 2, the effect of wave *and current* erosion when protection by living organisms is only partial.

The former case is that universal in the Red Sea, and found in the North Basin of Khor Dongonab, the latter the peculiarity of the Main Basin.

Currents.—A glance at the chart of the Khor shows how its peculiar contour must result in the formation of especially strong currents whenever there is any small change of sea-level outside. The Red Sea is not nearly of so constant a level at this latitude as at Port Sudan or Suakin. Records have been kept at Dongonab for several years, and show that the difference between maximum and minimum levels amounts to 80 cms., but that the alteration of level rarely or never exceeds 50 cms. in the 24 hours. Consequently there are no violent tide-races formed as there would be with a tide of say 1 or 2 metres only. The strongest local current I have actually observed ran at perhaps 3 knots, but this was rather exceptional. We have indeed a good example here of the considerable effects produced by currents of quite moderate strength and carrying very little silt. That these banks have been, and are being, carved out by currents is obvious on inspection, their areas of smooth rock, bare or covered with a very little sand or here and there by nodules of *Lithothamnia*, could be produced in no other way. I have had occasion to look for soft patches for anchoring on these banks, and on seeing a bottom of sand have sent down a diver with a crowbar to test its depth. It has almost always been found only an inch or two deep, and too coarse and clean to be brought up by a dredge-net that would retain quantities of ordinary sea-sand or mud. The water is generally clear, pearl shells, half hidden among weed or sponge, being picked out by the natives, using a "water telescope," at depths of from three to ten fathoms. The former is the average depth at which shells can be seen all the year round, the latter rather exceptional, but both depths are of course a long way short of that at which a white plate would be visible. The dirtiest water is due to wealth of micro-plankton rather than to mud. The absence of coral can only be attributed to the destruction of its newly-settled larvæ by the rasping of current-swept silt, not to the current alone; and the distribution of other organisms as well as of corals agrees with this theory. Coral reefs are found where the currents are least strong, and this in spite of the fact

that in these places the water is far dirtier than elsewhere—that is to say, inside Dongonab Harbour and Khor Atôf, besides in the North Basin (see Map 2, Pl. 29). As for other organisms, familiarity with these areas and watching the results of the pearl-divers shows clearly that the only organisms that can occur in any numbers upon them are those which have well-protected larvæ. For instance, among the Lamellibranchiata, all the Aviculidæ, so common elsewhere, are rare here, being only found where they had some shelter during the youngest stages. Once above a diameter of 10 cm. the large pearl-oyster (*Mytilus margaritifera*) lives and grows well here, where its newly settled larva cannot exist. The Lamellibranchiata that flourish here are such heavy shells as *Chama*, *Spondylus*, and *Ostrea* ; and it is to be noted that in these species the smallest shells seen, say 2 mm. across, are already hard and solid, in very marked contrast to the extreme delicacy of the Aviculidæ of the same size. Similarly seaweeds except *Lithothamnia* are generally absent ; the Phyllospongiidæ, which occupy the ground, may be presumed, like other sponges, to have larvæ well provided with a skeleton, in this case of tough fibre, at the time they settle.

In 1902 I suggested * that the absence of corals from the outer reef-edges of Zanzibar and British East Africa was due to the fouling of the water by sand and organic matter from the broad reef-flats. My experience of Khor Dongonab leads me to believe that the amount of sand carried out from the Eastern reefs of Zanzibar, and the strength of the current which impinges upon them, is much more than sufficient to account for the absence of coral, for which at that time the explanation I offered appeared to me not altogether adequate.

Extension of Lagoons.—From the foregoing it is evident that one must never suppose that the existence, even in fair abundance, of Corals and *Lithothamnia* necessarily indicates the extension by growth of a reef. The rate of increase of a reef is not merely the sum of the growths of its individual colonies, but is a balance between growth and forces of degradation. Coral is quite common, for instance, about the base of a wall, built of corals from the reef, near the salt works. This has been in existence about twelve years, and while the solution of its base is very evident, the addition made by the coral colonies growing upon it is practically nil. Similarly on the outer reefs about Dongonab all dead coral is found to be rotten with sponge and worm borings, rapidly crumbling into mud, while the bases of even living colonies are generally in the first stage of decay. For instance, a fragment of *Porites* picked up at random from a pile of coral brought in for building purposes,

* "The Coral Reefs of Pemba Island and of the East African Mainland," Proc. Camb. Phil. Soc. vol. xii. part i. (1903) pp. 36–43; and "Coral Reefs of Zanzibar," Proc. Camb. Phil. Soc. vol. xi. (1902) pp. 493–503.

though growing healthily above and partly coated with *Lithothamnia* &c. below, is full of minute holes round the base, which are the openings of sponge and worm borings, while another fragment showed the openings of 18 *Lithodomus* borings. This borer is very common; one meets corals, still living, in which its burrows are much more abundant, being nearly as close-packed as those of *Teredo* in waterlogged wood. In short the active growth of Coral and *Lithothamnia* may delay, but certainly does not prevent, the extension of the sea all along the western shore of the Bay.

Summary.

1. There have been three successive lines of barrier reef along the Red Sea Coast, which, by continual uplift, have become:

(1) A range of sandstone hills rising from the alluvial maritime plain;
(2) A fringe of limestone along the present coast-line;
(3) The present barrier system.

2. These three ridges were formed by folding and faulting of sedimentary rocks which overlay the bases of the Archean hills at the time of the great movement which opened the Red Sea section of the Great Rift Valley.

3. The northern ends of several sections of the present barrier reefs are elevated above sea-level, and examination of these, especially the one forming Rawaya Peninsula, and of the hills forming the maritime plain, enables us to reach the above conclusions.

At the same time Rawaya gives evidence of a seaward movement as well as uplift, Khor Dongonab and some at least of the channels within the Barrier Reefs being recent fault-depressions, not merely the original anticlinal fold formed by the opening of the Rift Valley.

The harbours and other fissures in the coast are due to the same secondary faulting.

4. The maritime plain has had two maxima of seaward extension, the first being before, the second after the growth of coral on the second and third barriers. Owing to elevation nothing has been added to its seaward slopes since the formation of the features of the coast by secondary faulting.

5. The filling in of valleys and the completion of the connection of the second barrier with the maritime plain has been largely due to blown sand. The process is continuing, an extensive plain near Dongonab showing perfect uniformity in its formation. The effect of climate and vegetation on the formation of the plain is described (Plate **34**).

6. Of the possible mode of formation of the widely distributed gypsum deposits the theory favoured is by the evaporation of a shallow sea which is presumed to have existed before the deep Rift Valley was made. The recent

and still continuing deposition of gypsum beneath the Rawaya salt field is an interesting actual example of this method.

7. The restriction of coral growth within Khor Dongonab, a very exceptional if not unique state of things in the Red Sea, is shown to be the result of abrasion by silt-carrying currents. Considerable effects follow from comparatively feeble currents which carry very little sand, but that this is sufficient to prevent the fixation of coral larvæ is borne out by the comparison of newly fixed spat of those mollusca which do flourish on these current-swept banks with those of the Aviculidæ, *e.g.*, which flourish on the coral areas.

8. That on its west shore Khor Dongonab is extending itself at the expense of the land in spite of the presence, in some abundance, of coral and *Lithothamnia*. The presence of these must not be assumed to imply the addition of material to a reef unless their growth can more than counterbalance the forces of degradation.

EXPLANATION OF THE PLATES.

Plate 28.

Map 1.—General view of the Red Sea, showing Jedda, Port Sudan, &c.

The outline of the coast is a double line, the outer representing the edge of the fringing reef. The shoal areas bearing the barrier reefs are shown outside these; they are especially regular between Ras Salak and Suakin.

The map includes the whole coast-line of the Anglo-Egyptian Sudan, between the Egyptian and Italian Boundaries.

Sandstone hill-ranges are shaded.

Plate 29.

Map 2.—Larger scale, showing position of Khor Dongonab.

(1) Small islands are black, thin lines enclose shoal areas bearing reefs.

(2) *Distribution of Coral.*

Growing coral is shown by shading. Such an area enclosed by a line represents a coral reef with definite edge, but the existence of many reefs can only be indicated in writing. Bare rock-slopes are indicated by lines of dots.

(3) *Depths*:—10- to 20-fathom line —. —. — .—

100-fathom line - - - - - - - - - - - - - - - -

The numbers refer to depths in fathoms.

The chart made by Commander Walter in H.M.S. 'Merlin' in 1907 is extremely interesting (Admiralty Plan No. 3722). This is the only large-scale chart giving detailed soundings of a part of the outer edge of the Barrier System. The great submarine precipice found along the 100-fathom line and the practical coincidence of the 10- and 20-fathom lines (these cannot generally be shown separately even on the large chart) are striking examples of fault escarpments along the sides of the Rift Valley. The chart also demonstrates the connection of the Rawaya range with the Têlat reefs by an area 9–15 fathoms deep studded with small surface-reefs rising precipitously from these depths.

Plate 30.

Map 3.—Sketch-map of Salak and the Barrier reefs extending from its point.

Soundings with line and dot above mean that so many fathoms of line were run out without reaching the bottom. Small crosses indicate presence of dangerous rock.

Plate 31.

Map 4.—Jedda Reefs.

The reefs round Jedda illustrate the parallelism of the structures of either side of the Red Sea, and are a case of this effect influencing features of a very small scale equally with such larger things as hill-ranges.

Surface-reefs are shaded. Shore and islands dotted.

5-fathom line - - - - - - - - - - - - - - - - - -

10-fathom line —·—·—·—

It will be noticed that the 5- and 10-fathom lines are frequently coincident.

Three miles west of the outermost reef of this chart the plateau shoals from 30 to 15 and 10 fathoms and bears several shoals. This area is closely skirted by the 100-fathom line, and 200 fathoms is found $\frac{1}{4}$ mile further west.

Plate 32.

Three Views on Rawaya.

1. Entrance to Khor Atôf; notice the river-like appearance of this inlet, and the very low land surrounding it. The dark line along the horizon, here only half a mile away, is the land on the other side of the Khor, and shows how low-lying is the greater part of Rawaya (*cf.* fig. 2). Foreground is composed of *sections* of coral and shells of an elevated reef; the actual shore is sandy and bears a little vegetation, that included in the photograph being *Salicornia fruticosa.*
2. The Salt Field, Jebel Abu Shagara beyond it.
3. The ravine of Jebel Abu Shagara, showing :—
   (1) A shallow layer of coral;
   (2) Six feet of gypsum;
   (3) Sandstone, containing glassy sheets of selenite, recrystallised from the gypsum.

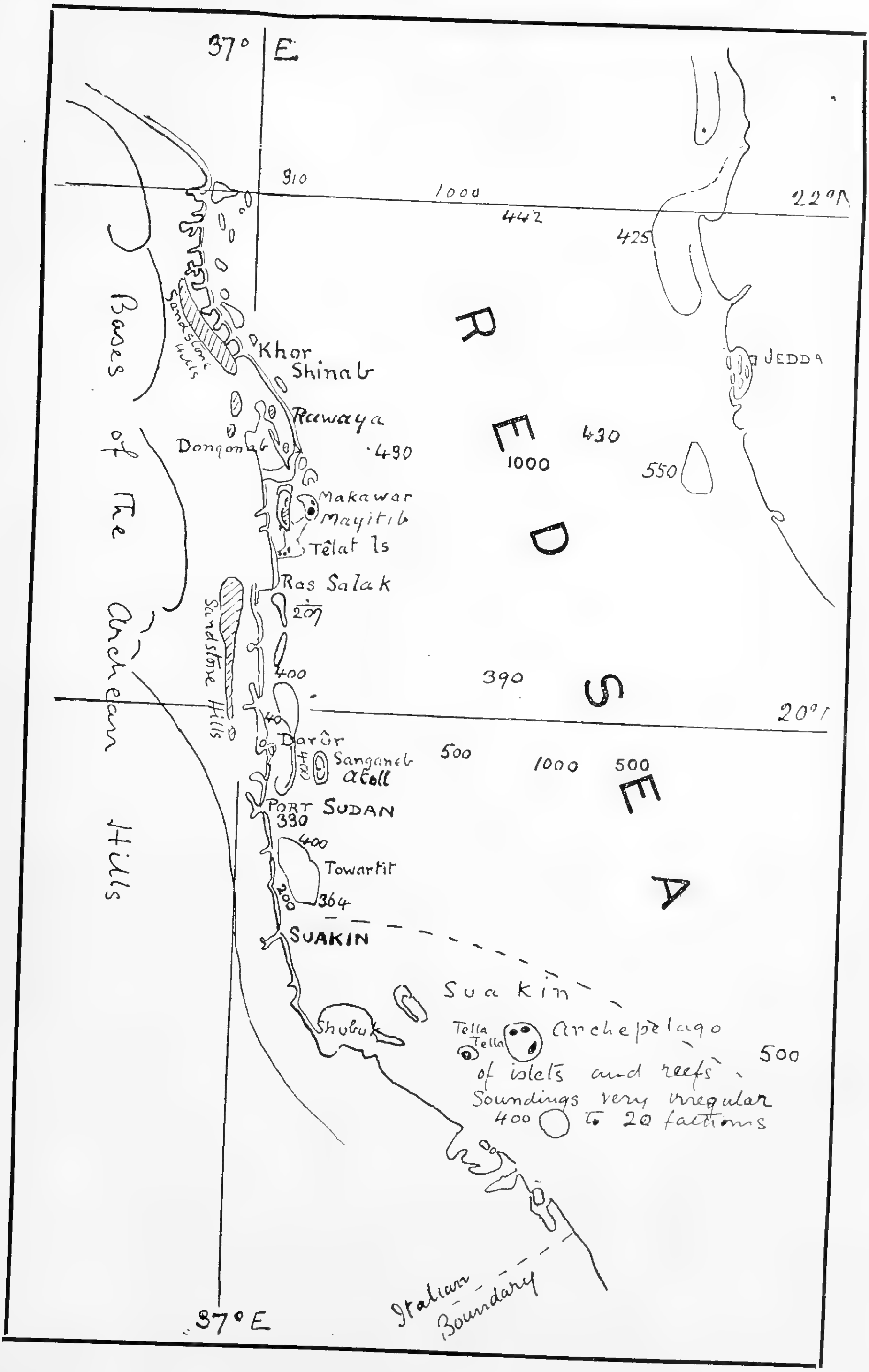
Plate 33.

Figs. 1 & 2. Corals in position of growth on the summit of Jebel Têtawib. Notice their perfect preservation.

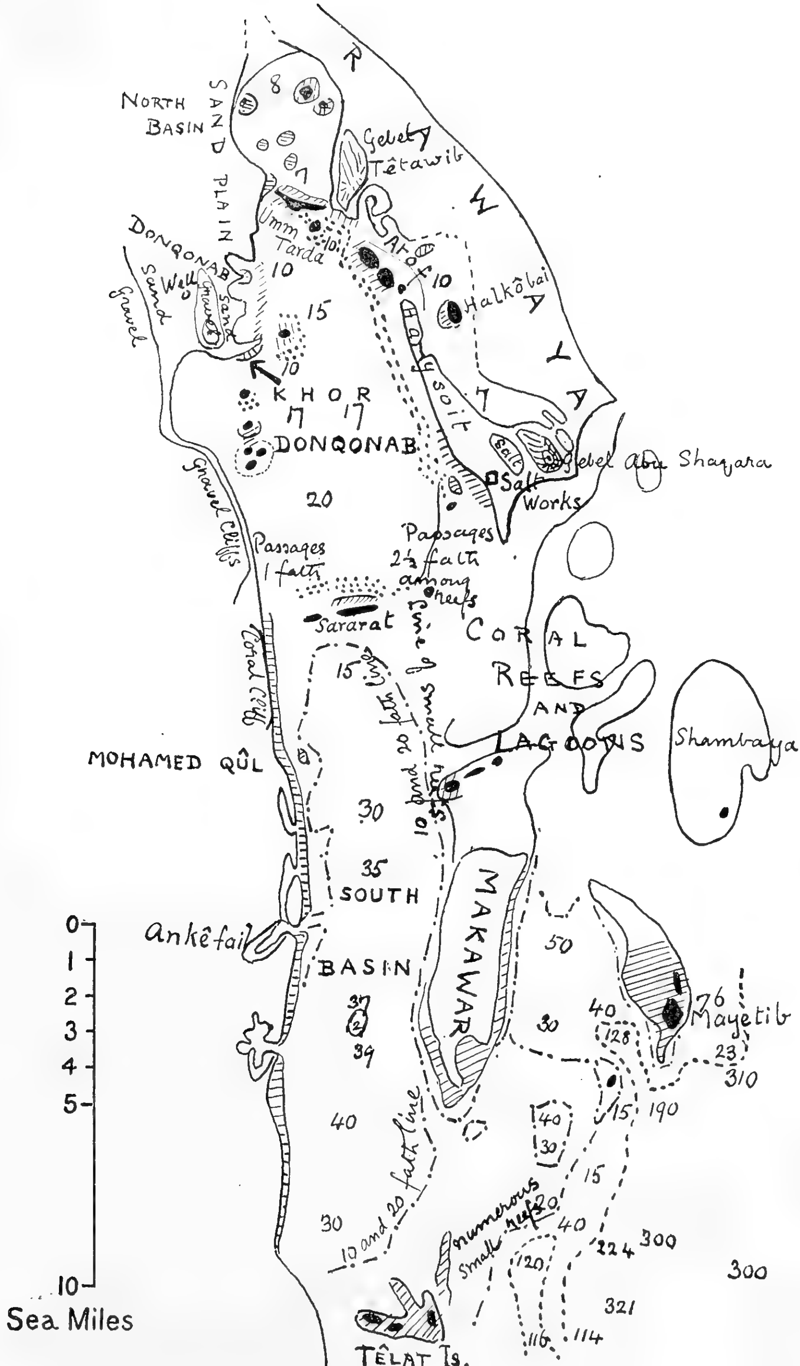
3. An example of the undermined cliffs of the Red Sea Coast. These are on the west side of Rawaya. Note how the same undermining is beginning on the fallen blocks in the foreground.

Plate 34.

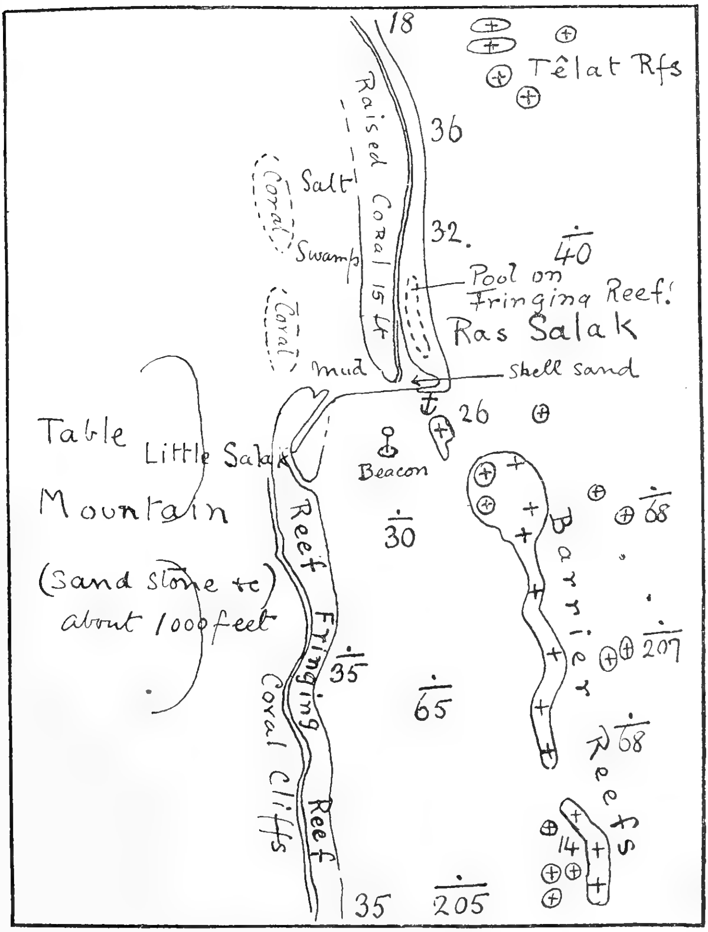
Looking across Dongonab Harbour in a southerly direction, *i. e.* from directly behind the sand hillocks. In the foreground is the most recent and not yet perfectly consolidated part of the sand plain, and the line of *Suaeda* and sand hillocks which bounds it seawards. Across the bay is the native village on the same low-lying sand, the rising ground to the right being Dongonab Hill, of the older gravelly alluvium.



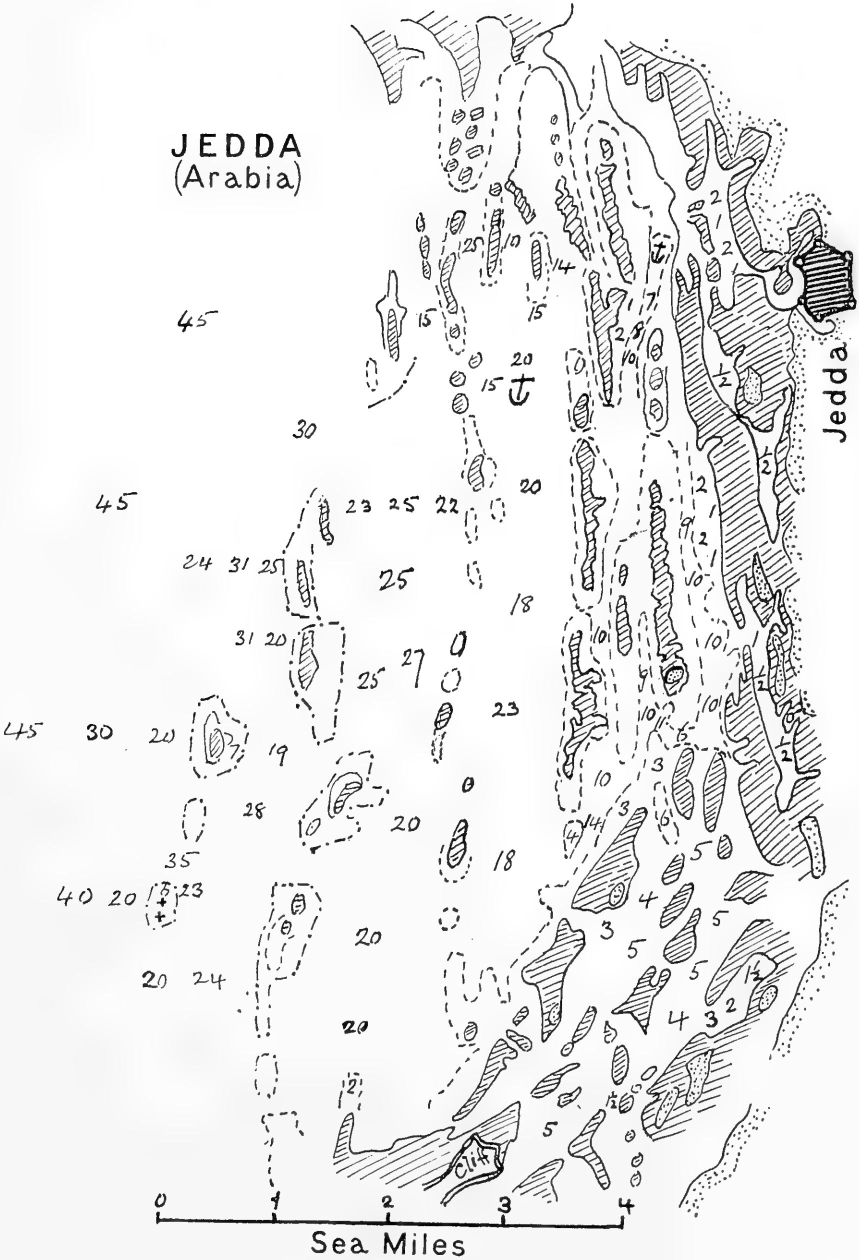
Map 1.—GENERAL VIEW OF THE RED SEA.



Map 2.—POSITION OF KHOR DONGONAB.



Map 3.—SALAK AND BARRIER REEFS.

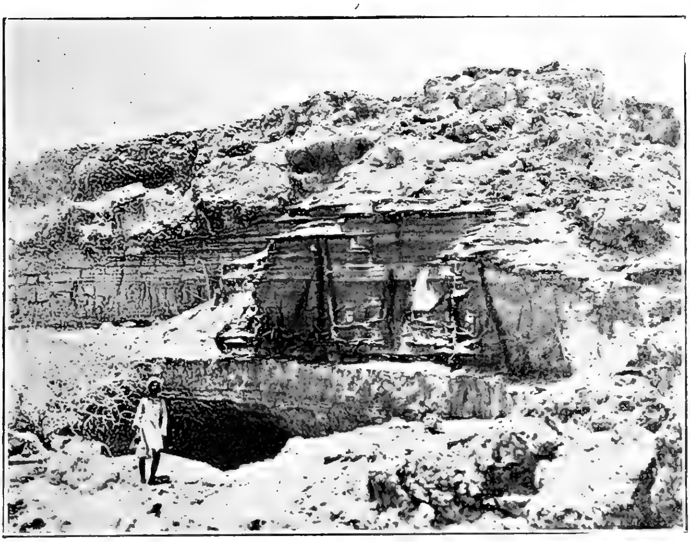


Map 4.—JEDDA REEFS.

1

2

3



Grout sc.

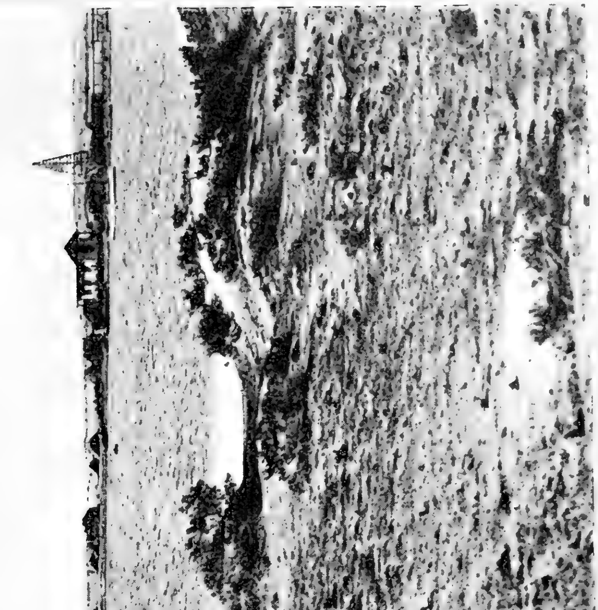
THREE VIEWS ON RAWAYA.

1

2

3

CORALS AND UNDERMINED CLIFFS.



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DONGONAB HARBOUR.

REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA, from Collections made by CYRIL CROSSLAND, M.A., B.Sc., F.Z.S. (Communicated, with an Introduction, by Prof. W. A. HERDMAN, D.Sc., F.R.S., F.L.S.) —XIX. REPORT on the SPONGES collected by Mr. CYRIL CROSSLAND in 1904–5. Part II. NON-CALCAREA.

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(PLATES **35–41** and 26 Text-figures.)

[Read 15th December, 1910.]

INTRODUCTION.

THE present report deals with 77 species and varieties, belonging to 44 genera, of Non-Calcareous Sponges, and is the second (and concluding) part of the report on the Red Sea sponges collected by Mr. Crossland in the years 1904–5. The TRIAXONIDA are not represented in the collection, doubtless because the specimens were obtained entirely from coastal waters, and not from the deeper parts of the Red Sea, where Hexactinellid sponges are known to occur, Schulze having described three species from this region. The other orders of the NON-CALCAREA are all represented in the following proportion:—

MYXOSPONGIDA, 2 species.
TETRAXONIDA, 49 species, of which 24 are new, including 2 new genera.
EUCERATOSA, 26 species, of which 7 are new, including 2 new genera.

The classification adopted in this report is based upon that of Prof. Dendy (**11**), in which the NON-CALCAREA are divided into 4 orders of equal importance, viz., MYXOSPONGIDA, TRIAXONIDA, TETRAXONIDA, and EUCERATOSA, the last three groups, which differ from each other in the type of their skeleton, being each derived separately from the askeletous MYXOSPONGIDA.

In classifying the Tetraxonida, Prof. Dendy recognises 3 "Grades," TETRACTINELLIDA, MONAXONELLIDA, and LITHISTIDA. These groups are not considered to be necessarily monophyletic in origin, but he looks upon them as convenient divisions for classificatory purposes, owing to the very easily recognisable characters by which they are distinguished from each other. He then further divides his grades as follows:—

Order TETRAXONIDA.
  A. Grade **Tetractinellida.**
    Sub-Order 1. HOMOSCLEROPHORA.
      ,, 2. ASTROPHORA.
      ,, 3. SIGMATOPHORA.

B. Grade **Monaxonellida.**

Sub-Order 1. ASTROMONAXONELLIDA.

,, 2. SIGMATOMONAXONELLIDA.

C. Grade **Lithistida.**

With the Lithistida I do not propose to deal, as there are no species in the collection. Of the other sub-orders, the Homosclerophora do not have their spicules differentiated into mega- and microscleres, the Astrophora and Astromonaxonellida both have microscleres derivable from the aster, and the Sigmatophora and Sigmatomonaxonellida both have microscleres derived from the sigma as the original type. Also it is considered that the Astromonaxonellida are derived from the Astrophora, and the Sigmatomonaxonellida from the Sigmatophora.

In this article I propose to follow the modification of this proposed by Hentschel (**15**), who abandons the "Grades" TETRACTINELLIDA and MONAXONELLIDA completely, and divides the whole of the TETRAXONIDA (except the LITHISTIDA, which he does not deal with) into 3 sub-orders as follows:—

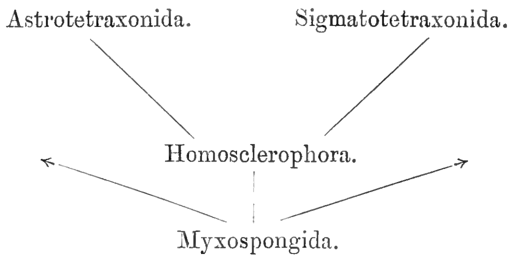
Order TETRAXONIDA.

Sub-Order 1. HOMOSCLEROPHORA.

,, 2. ASTROTETRAXONIDA (= Astrophora + Astromonaxonellida).

,, 3. SIGMATOTETRAXONIDA (= Sigmatophora + Sigmatomonaxonellida).

The second and third of these thus form homogeneous and monophyletic groups each immediately derived from the Homosclerophora, thus:—



The complete list of species described in this report is appended.

Order **MYXOSPONGIDA.**

Fam. HALISARCIDÆ.

Halisarca dujardinii, Johnston.

Halisarca sp.

Order **TETRAXONIDA.**

Sub-Order **Homosclerophora.**

Fam. PLAKINIDÆ.

Placortis simplex, Schulze.

Sub-Order **Astrotetraxonida.**

Fam. STELLETTIDÆ.

Pilochrota parva, n. sp.

Fam. GEODIIDÆ.

Geodia micropunctata, n. sp.

Fam. EPIPOLASIDÆ.

Coppatias albescens, n. sp.
Diastra sterrastræa, n. g. et sp.

Fam. TETHYIDÆ.

Tethya lyncurium, Linnæus.
Tethya seychellensis (Wright).

Fam. SUBERITIDÆ.

Suberites carnosus, Johnston.
Pseudosuberites hyalina (Ridley & Dendy).

Fam. CLIONIDÆ.

Cliona celata, Grant.

Sub-Order **Sigmatotetraxonida.**

Fam. TETILLIDÆ.

Tetilla poculifera, Dendy.
Paratetilla eccentrica, n. sp.
Chrotella ibis, n. sp.

Fam. HAPLOSCLERIDÆ.

Sub-Fam. RENIERINÆ.

Reniera implexa, O. Schmidt.
Reniera spinosella, n. sp.
Reniera tabernacula, n. sp.
Reniera sp.
Halichondria bubastes, n. sp.
Halichondria sp.
Trachyopsis halichondrioides, Dendy.

Sub-Fam. CHALININÆ.

Pachychalina variabilis, Dendy.
Ceraochalina densa, Keller.
Chalina minor, n. sp.
Siphonochalina communis, Carter.
Siphonochalina tubulosa, Ridley.
Siphonochalina conica (Keller).
Spinosella sororia (Duchassaing & Michelotti).
Spinosella incrustans, n. sp.

Sub-Fam. GELLIINÆ.

Gelliodes poculum, Ridley & Dendy.

Sub-Fam. HETEROXYINÆ.

Anacanthæa nivea, n. g. et sp.

Fam. DESMACIDONIDÆ.

Sub-Fam. ESPERELLINÆ.

Esperella dendyi, n. sp.
Esperella euplectellioides, n. sp.
Esperella fistulifera, n. sp.

Sub-Fam. ESPERELLINÆ (*con.*).
Esperella suezza, n. sp.
Esperella erythræana, n. sp.

Sub-Fam. ECTYONINÆ.
Myxilla isodictyalis (Carter).
Myxilla cratera, n. sp.
Myxilla tenuissima, n. sp.
Ophlitaspongia (?) *arbuscula*, n. sp.
Ophlitaspongia (?) *horrida*, n. sp.
Ophlitaspongia (?) *digitiformis*, n. sp.

Sub-Fam. TEDANIINÆ.
Tedania assabensis, Keller.

Fam. AXINELLIDÆ.
Hymeniacidon calcifera, n. sp.
Hymeniacidon zosteræ, n. sp.
Acanthella aurantiaca, Keller.
Phakellia donnani (Bowerbank).
Phakellia palmata, n. sp.
Ciocalypta tyleri (Bowerbank).

Order **EUCERATOSA.**

Fam. APLYSILLIDÆ.
Megalopastas erectus, n. sp.
Darwinella aurea (?), Müller.

Fam. SPONGELIIDÆ.
Spongelia ædificanda, n. sp.
Spongelia delicatula, n. sp.
Psammopemma commune (Carter).
Dysidea cinerea, Keller.
Euryspongia lactea, n. g. et sp.

Fam. SPONGIIDÆ.
Heteronema erecta, Keller.
Duriella nigra, n. g. et sp.
Hircinia variabilis var. *typica*, O. Schmidt.
Hircinia variabilis var. *hirsuta*, O. Schmidt.
Hircinia fasciculata (Esper).
Hircinia ramosa, Keller.
Hircinia rugosa, Lendenfeld.
Aplysina reticulata, Lendenfeld.
Aplysina inflata, Carter.
(?) *Aplysina purpurea*, Carter.
Aplysina mollis, n. sp.
Aplysina prætensa, n. sp.
Cacospongia cavernosa (Esper).
Phyllospongia radiata (Hyatt).
Phyllospongia madagascariensis (Hyatt).
Phyllospongia cordifolia (Keller).
Euspongia zimocca (O. Schmidt).
Euspongia officinalis var. *arabica*, Keller.
Euspongia officinalis var. *ceylonensis*, Dendy.

All reference to the geographical distribution of these species is deferred until the end of the systematic part of the paper, where a full description of the distribution of the Red Sea species will be found, with a discussion of the relationship of the Red Sea sponge fauna to that of other parts of the world.

Only the most important references are given in the synonymy lists attached to the various species.

My warmest thanks are due to Professor Dendy for the very kind way in which he has placed his knowledge of the Porifera at my disposal during the whole of the work, and also for much valued assistance and advice.

The collection is to be deposited in the British Museum (Natural History Department).

Class **NON-CALCAREA.**

Porifera whose skeleton is typically not composed of calcium carbonate.

Order MYXOSPONGIDA.

Non-Calcarea which are primitively destitute of spicules and horny fibre: with simple canal-system and usually large flagellate chambers.

Family HALISARCIDÆ.

HALISARCA DUJARDINII ?

Synonymy:—

1842. *Halisarca dujardinii,* Johnston (**17**).

There is a single specimen in the collection which has been tentatively identified as this species, though the malpreservation of the material has prevented any very certain identification. It consists of a small cushion-like mass, about 30 mm. × 15 mm., growing on a piece of coral. The surface appears lined with shallow grooves, which are the external indications of the folding of the choanosome in the sponge. In these grooves doubtless lie the inhalant and exhalant apertures, though definite oscula and pores have not been made out. Large irregular inhalant or exhalant canals always occur immediately beneath these grooves.

The folding of the choanosome is clearly distinguishable, and chambers of about 260 μ × 40 μ are arranged in a single series around the folds. No details of collared cells or canaliculi leading from or to the inhalant or exhalant canals could be made out.

The ectosome is very thin, and apparently not to be distinguished from the mesoglœa of the chamber layer.

The colour in spirit is dirty grey.

Locality. We Shubuk (S.E. corner).

Distribution. Red Sea, British Coasts, Mediterranean.

(?) HALISARCA sp.

Two mussel-shells occur in the collection covered with an extremely thin film of sponge, which apparently belongs to this genus. The chambers were few in number and very long, and large numbers of embryos occurred in the sponge. No other details could be made out.

The specimens were obtained from a buoy in Suez Harbour.

Order TRIAXONIDA.

No Hexactinellid sponges were obtained by Mr. Crossland, but Schulze (**27**) describes the following three species from the deeper parts of the Red Sea :—

Aulocystis grayi (Bowerbank).
Aulocystis zitteli (Marsh & Mayer).
Tretocalyx polæ, Schulze.

Order TETRAXONIDA.

Non-Calcarea in which the fundamental form of the spicule is tetraxonid and tetractinellid ; the spicules may, however, be more or less reduced, and also to a greater or less extent replaced by spongin or even sand.

Sub-Order HOMOSCLEROPHORA.

Tetraxonida in which megascleres and microscleres are not sharply differentiated from each other, and no triænes are developed.

Family PLAKINIDÆ.

Homosclerophora in which no distinct cortex is developed.

PLACORTIS SIMPLEX, *Schulze*.

Synonymy :—
1880. *Placortis simplex*, F. E. Schulze (**28**).
1895. *Placortis simplex*, Topsent (**34**).

A single small somewhat irregular specimen of this sponge was obtained on Suez mud-flats, measuring 15 mm. × 8 mm. The colour is yellowish white. The skeleton is exactly like Schulze's description.

Distribution. Red Sea, Mediterranean.

Sub-Order ASTROTETRAXONIDA, *Hentschel* (**15**).

Tetraxonida which possess astrose microscleres, or are derived from such aster-possessing forms.

Family STELLETTIDÆ.

Astrotetraxonida with long shafted triænes, without calthrops and without sterrasters.

PILOCHROTA PARVA, n. sp. (Pl. **35.** fig. 3, Pl. **36.** fig. 6; text-fig. 1.)

The only specimen of this new species in the collection is a small, irregular but complete specimen, without any indication of attachment, and measuring about 20 mm. by 15 mm.

Several prominences and protuberances occur on the sponge, and it is quite impossible to distinguish an upper or lower surface. Two comparatively large oscula occur on the specimen, one near each end of the sponge, and each is somewhat oval in shape. The larger measures 1·2 mm. in its longest diameter and the smaller measures 0·8 mm. The pores are extremely numerous and are thickly distributed over the whole surface. There are no special pore-areas, but the pores frequently lie at the bottom of slight depressions on the sponge surface.

The texture is hard and brittle, and the colour in spirit white.

The surface of the sponge is perfectly smooth, there being no projecting spicules whatever, though slight irregularities and pits occur over the surface.

The cortex is 1·0 mm. thick, and definitely marked off from the choanosome. It contains numerous large subdermal cavities, which are oval in shape, with the long axis of the oval lying vertically in the sponge. Between these cavities occur fan-like groups of spicules composed almost entirely of ortho- and anatriænes, the heads of which lie immediately below the dermal membrane. The rays of these triænes lie nearly always wholly in the cortex, very rarely projecting into the choanosome.

Immediately below the cortex lie the heads of the triænes of the main skeleton, which is radially arranged, but not gathered up into distinct fibres or bundles of spicules. Amongst the triænes lie large numbers of oxea. Both the cortex and the choanosome are filled with enormous quantities of chiasters.

Spicules.

A. Megascleres.

(α) Orthotriænes. (Text-fig. 1, A.)

The orthotriænes of the cortex are not to be distinguished from those of the choanosome. The rhabdome is conical, delicately pointed, and is thickest at the head, and quite straight. Its length is from 1·0 mm. to 1·15 mm. and the average thickness is 0·023 mm. The cladi are fairly long, curved from the base onwards, and frequently recurved back again to the horizontal They reach a length of 0·2 mm. in the largest specimens.

(β) Anatriænes. (Text-fig. 1, B.)

The anatriænes are slender-shafted and but little longer than the orthotriænes. The rhabdome is straight, conical, and very finely pointed; it measures from 1·0 to 1·28 mm. in length, and 0·009 to 0·015 mm. in diameter. The cladi are abruptly recurved, so as to lie parallel with the shaft in their distal portions. They are rather short, not exceeding 0·1 mm. in length, and they are of an equal thickness with the rhabdome at their junction with it.

The sagitta of the head is 0·06 mm. and the chord is 0·055 mm.

(γ) Oxea. (Text-fig. 1, C.)

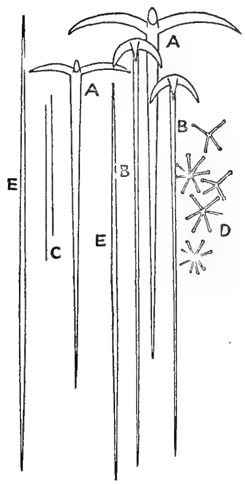


Fig. 1.—*Pilochrota parva*. A, B, C, and E × 60; D × 1100.

(i.) The oxea of the main skeleton are very sparse in the cortex, but occur in great numbers in the choanosome. They are straight, thickest in the centre, and gradually tapered to the ends, which are very finely pointed. The oxea vary very much in length, and specimens may be found measuring anything between 1·0 mm. and 2·6 mm. in length. The thickness is, however, fairly constant and averages 0·02 mm.

(ii.) In addition to the large oxea, much smaller specimens, irregularly scattered through the sponge-body, can be found. These are apparently not young forms of the large oxea, but an entirely different spicule, similar to the somal oxea of *Pilochrota variabilis*, Wilson. They are extremely slender, and almost raphide-like. They measure 0·25 to 0·37 mm. in length, and have a maximum thickness of about 8 μ.

B. Microscleres.

The only microsclere which occurs is a small chiaster, with a very slight centrum and 6–10 rays. The diameter of an average specimen is 0·007 mm.

The present species occupies an intermediate position between several previously described species. These are *P. haeckeli*, Sollas, *P. pachydermata*, Sollas, *P. lendenfeldi*, Sollas, and *P. variabilis*, Wilson. All these species differ from one another in shape, and also to some extent in their spicular measurements. Nor does *P. parva* agree with any of them with sufficient accuracy to be identified therewith, though any one of the spicules of *P. parva* can be almost exactly duplicated in one or other of the above species.

For purposes of comparison I therefore give a table (p. 295) of these five species, with details of the spicular measurements &c.

Locality. Suez.

Distribution. Red Sea.

		P. parva.	*P. haeckeli.*	*P. pachydermata.*	*P. lendenfeldi.*	*P. variabilis.*
Locality		Red Sea.	Philippines.	Reefs off Tahiti.	E. Moncour I., Bass Str.	Porto Rico.
Shape		irregular, massive.	subglobular.	massive, irregularly lobed.	spheroidal, stalked, no apparent osculum.	sphæroidal, flattened.
Colour		white.	grey.	surface purplish, interior yellowish white.	dark umber-brown.	white to grey-brown.
Orthotriæne. A.	rhabdome	1·0–1·15×0·023 mm.	2·18×0·55 mm.	1·114×0·022 mm.	2·856×0·05526 mm.	1·35–1·7×0·012–0·024 mm.
	cladi, length	0·2 mm.	0·238–0·318 mm.	0·12 mm.	....	0·1–0·25 mm.
Orthotriæne. B.	rhabdome	....	....	....	....	0·5×0·004 mm.
	cladi, length	....	....	....	....	0·02–0·024 mm.
Anatriæne.	rhabdome	1·0–1·28×0·009–0·015 mm.	3·03×0·035 mm.	1·35×0·0158 mm.	1·75×0·0237 mm.	1·53–2·21×0·02–0·024 mm.
	cladi, length	0·1 mm.	0·16 mm.	0·067 mm.	0·1 mm.	0·044–0·084 mm.
	sagitta	0·06 mm.	0·16 mm.	0·055 mm.	0·095 mm.	0·02–0·08 mm.
	chord	0·055 mm.	0·16 mm.	0·099 mm.	0·127 mm.	....
Oxea.	A.	1·0–2·6×0·02 mm.	2·07×0·040 mm.	1·193×0·0178 mm.	2·5×0·0434 mm.	1·02–1·6×0·012–0·016 mm.
	B.	0·25–0·37×0·008 mm.	....	....	....	0·168–0·2×0·006–0·008 mm.
Chiaster		6–10 rays—0·007 mm. in diam.	3–7 rays—0·016 mm. in diam.	5–8 rays—0·006–0·011 mm. in diam.	numerous rays—0·007–0·018 mm. in diam.	about 8 rays—0·012–0·016 mm. in diam.
Cortex		1·0 mm. thick, with large subdermal cavities and bundles of triænes between them.	0·8–0·95 mm. thick.	1·0 mm. thick.	0·9 mm. thick, with tangential canals.	0·7 mm. thick.

Family Geodiidæ.

Astrotetraxonida in which the characteristic microsclere is a sterraster forming a dense cortical layer.

Geodia micropunctata, n. sp. (Pl. **35.** fig. 5, Pl. **40.** fig. 24; Text-fig. 2.)

This new species is represented in the collection by several incomplete specimens, all but two of which consist merely of pieces of the sterraster crust, without any of the interior of the sponge. The two species in which the choanosome is present as well as the cortex are both apparently fragments broken off from larger individuals. They are irrgeular and massive in shape, and each presents a relatively large surface of exposed choanosome where they have been torn away, either from their support or from the rest of the specimen. The largest specimen measures about 100 mm. long by 90 mm. wide, and the smaller about 60 mm. by 55 mm.; each of the specimens being about 30 mm. to 35 mm. thick. There is no foreign matter whatever attached to the larger specimen; but the smaller is growing over and partially enclosing a group of mussels (one of which is shown in Pl. **35.** fig. 5), and two of the fragments of sterraster crust are also attached to mussels.

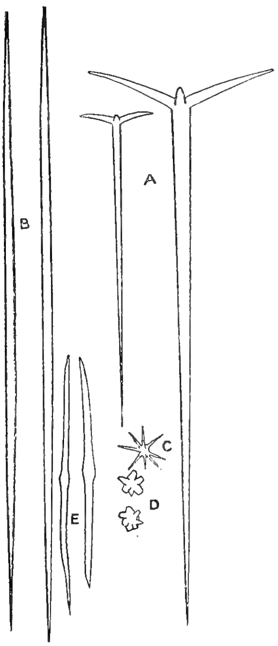


Fig. 2.—*Geodia micropunctata.* A and B ×60; C, D, and E ×1000.

The surface of the sponge is gleaming white and is perfectly smooth, no spicules whatever projecting from it. It is pierced by a number of small circular oscula, irregularly scattered over the surface of the sponge and varying in size from 0·2 mm. to 0·8 mm. in diameter. On the larger specimen the oscula are somewhat few and do not grow to any large size, and this is the case with the greater portion of the surface of the small specimen. There occurs on the smaller specimen, however, a portion of the surface of the under side of the sponge, and here the oscula are many in number and of comparatively large size (see Pl. **35**). This probably furnishes the explanation of the entire absence of large oscula from the large specimen, as no portion of the under surface is present in that specimen. In many cases there is present a clearly defined oscular sphincter membrane, which is frequently more or less closed. In all

probability those oscula which do not show this membrane possess it, but in those cases it is rendered invisible by being widely open.

There also occur, scattered over the sponge surface, and apparently no more frequent on the under side of the sponge than on the upper, a number of much smaller apertures, over the great majority of which there stretches a membrane. These are in all probability pore-areas; but microscopical examination of the covering membrane has not revealed any pores, so that these apertures may possibly be closed oscula. The diameter of these small apertures is about 0·1 mm.

The colour in spirit is gleaming white on the outside, and white with a tinge of yellowish grey in the interior.

The ectosome is clearly differentiated into a cortex, which is about 1·0 mm. to 1·2 mm. thick and which is distinctly fibrous in the region below the sterraster crust. Owing to the density with which the sterrasters are packed in the outer portions of the cortex, the character of the cortex cannot be made out in that region. The cellular elements, if there are any occurring in the cortex, were not distinguishable, and the cortex was quite hyaline.

Skeleton arrangement. (Pl. **40**. fig. 24.)

The cortical skeleton consists of a dermal layer of minute chiasters, very thickly scattered over the whole sponge surface, and especially thickly lining the sides of the vents. Below them lie the sterrasters, which are packed into a solid mass 0·6 mm. to 0·8 mm. thick, extending over the whole sponge surface, and only interrupted at the oscula (and at the presumed pore-areas). The main skeleton is radial, but only partially composed of spicular fibres, large numbers of spicules lying separately in the choanosome. The spicular bundles which do occur are, however, frequently very large, sometimes as much as 0·5 mm. in diameter. They are very deeply packed together, and in the deeper parts of the sponge consist almost entirely of oxea, the heads of the triænes lying either in the deeper parts of the cortex or immediately below it.

Spicules. (Text-fig. 2.)

A. Megascleres.

(α) Triænes. (Text-fig. 2, A.)

There only occurs one form of triæne in this species, an almost typical orthotriæne. The rhabdome is straight, thickest at the junction with the cladi, and gradually tapering to the point. The cladi are somewhat long, as stout as the rhabdome, and very slightly recurved. Like the rhabdome, they also taper from base to point. The heads of the triænes never lie within the layer of sterrasters, but always either in the deeper parts of the cortex or in the more superficial parts of the choanosome. The rhabdome measures

0·77 mm. to 0·9 mm. in length in the largest specimens, and is 0·035 mm. in diameter at the thickest point. The cladi are 0·236 mm. long in full-grown specimens and 0·03 mm. in diameter at the base.

There are present also a few small plagiotriænes, which are apparently young specimens of the regular orthotriænes.

(β) Oxea. (Text-fig. 2, B.)

(i.) The large oxea of the main skeleton are quite straight, and thickest in the middle of their length. They form the main part of the radial skeleton, and the whole of it a little way below the cortex, but they never actually project into the cortex itself. The largest specimens considerably exceed in length the rhabdomes of the orthotriænes, sometimes reaching a length of 1·75 mm., though they do not exceed the triænes in diameter, being usually about 0·031 mm. thick. Oxea may be found in all stages of growth, from quite small specimens up to the largest.

(ii.) Quite distinct from the above oxea, much smaller ones can be found scattered irregularly, and rather sparsely, through the cortex and choanosome. They can be immediately distinguished from small specimens of the oxea of the main skeleton by the fact that they do not lie radially, but are irregularly scattered, quite without orientation. They are much more slender than the larger oxea, and measure 0·2 mm. to 0·24 mm. in length by 0·011 mm. in diameter in the largest specimens.

B. Microscleres.

(α) Sterrasters.

The sterrasters are almost spherical and, when fully grown, form an almost perfectly solid mass, on the surface of which it is only just possible to distinguish the actines. There is a distinct but not conspicuous hilum. No immature sterrasters could be distinguished in the cortical sterraster-crust; but in the choanosome, where the sterrasters also occur in considerable numbers, the proportion of developing specimens was extremely high.

From this it would seem that the sterrasters are formed in the choanosome and transferred to the cortex; if so, it would indicate a continually increasing thickness of the sterraster-crust, or a continual wearing away of the external regions of the crust, in all probability the latter.

The diameter of the fully formed sterraster is 0·06 mm. to 0·07 mm.

(β) Spherasters. (Text-fig. 2, D.)

The dermal spherasters are extremely small and irregular, about 5 μ in diameter, of which the centrum occupies one-half, or 2·5 μ, the individual rays being 1·0 to 1·5 μ long, as a rule. The spherasters only occur as a dermal layer, and not in the deeper parts of the cortex or choanosome.

(γ) Oxyasters. (Text-fig. 2, C.)

There are typical oxyasters sparsely scattered through the choanosome

and not occurring in the dermal cortex-wall. They measure about 7 to 8 μ in diameter and possess 6 or 8 rays on the average.

From the above description of the spicules of this species it will be seen to fall into Sollas's subgenus *Dirhabdosa* of the genus *Geodia*.

Locality. Three specimens were obtained from a buoy in Suez Harbour, and a fourth specimen was obtained at Khor Dongonab.

Distribution. Red Sea.

Family EPIPOLASIDÆ.

Astrotetraxonida with oxeote megascleres, and usually euasters for microscleres.

COPPATIAS ALBESCENS, n. sp. (Pl. **36.** fig. 9; Text-fig. 3.)

The present species has been founded upon a specimen of small size. It consists of a flattened lamella of somewhat triangular shape, and appears to have grown in an erect position, attached to a branching coral. The point of attachment is very small, and the sponge gradually increases in width to the summit. It measures 18 mm. high, 12 mm. wide at the top, and has a thickness of about 5–7 mm.

Two oscula occur near the top of the sponge, each possessing a clearly marked oscular membrane, which is partially closed over the osculum in each case. The oscula, when wide open, would measure 2–3 mm. in diameter.

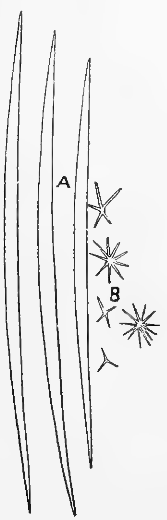


Fig. 3.—*Coppatias albescens.* A × 60; B × 500.

All over the surface of the sponge there occur very large numbers of small pore-areas (see photo, Pl. **36.** fig. 9). These pore-areas are nearly always situated at the bottom of very slight depressions, and rarely contain more than two or three pores. Many of the pore-areas in the photograph, in fact, will be seen to contain but a single pore, though a few cases may be seen where six or eight are visible in a single pore-area. The average pore-areas measure from 0·1 mm. to 0·15 mm. in diameter, and the pores themselves are usually not more than 0·05 mm. in diameter.

The sponge is of hard texture, and cannot be bent without breaking.

The colour in spirit is white.

The ectosome does not appear differentiated into a cortex, but there is present a special ectosomal skeleton in the form of a dense layer of minute oxyasters immediately below the surface of the sponge, and a very dense layer of oxea lying below the asters, which are typically tangential, but lie frequently quite irregularly between the tangential and vertical positions.

The skeleton consists chiefly of bundles of spicules, arranged more or less radially; but large numbers of spicules occur scattered through the sponge, and not bound up into bundles. The spicular bundles are fairly large, averaging 0·3 mm. in diameter, and in the deeper parts of the sponge are closely bound together. Dermally, however, they become somewhat plumose in character, and sometimes lose the appearance of fibres. The megascleres consist wholly of diactinal oxea of one kind; and the oxea of the spicular fibres cannot be distinguished either from those scattered about in the choanosome, or from those of the dermal tangential skeleton. Only one sort of aster is present, a minute euoxyaster.

Spicules. (Text-fig. 3.)

A. Megascleres. (Text-fig. 3, A.)

(i.) The somal oxea are typically somewhat curved, sometimes having a more or less definite angle in the middle, more frequently gradually throughout their length. They are thickest in the middle and gradually taper towards the ends. All sizes can be found, from minute raphide-like forms to the full-grown specimens, which measure 0·9 mm. to 1·1 mm. in length by 0·025 mm. to 0·04 mm. in diameter at the thickest part. The measurements of length are given from point to point, and not around the curve.

(ii.) There also occur oxea irregularly scattered throughout the sponge, and mixed with the above, which are rather longer and slightly more slender than the somal oxea. They are also quite straight, and taper gradually from the central point towards each end. When full-grown, they reach 1·4 mm. in length and 0·03 mm. in diameter.

B. Microscleres. (Text-fig. 3, B.)

The only microsclere is a euoxyaster, with pointed rays and very small centrum in most cases; but a very few asters were seen in which a well-defined centrum was discernible. These asters form a dermal layer, and also occur scattered in very large numbers throughout the sponge. They measure from 6 μ to 10 μ in diameter.

Locality. The single specimen in the collection was obtained at Tella Tella Kebira.

Distribution. Red Sea.

Genus Diastra, n. gen.

Epipolasidæ with spherasters of two kinds, one a minute dermal spheraster and the other large and simulating a sterraster.

The main skeleton consists almost entirely of a cortical layer of tangentially placed oxea.

DIASTRA STERRASTRÆA, n. sp. (Pl. 35. fig. 4; Text-fig. 4.)

This sponge is represented in the collection by a single specimen. It consists of an erect, somewhat rounded mass growing on a thin sheet of calcareous matter, possibly coral. The specimen shows a tendency to become lobose, but is not actually divided into lobes. It is, however, not a complete specimen; so that the typical external form of the species may differ from that of the specimen here described. The fragment obtained is about 35 mm. in height by 25 mm. in diameter. The surface of the sponge is slightly grooved, and these grooves run nearly vertically down the sponge, but they do not seem to be connected either with oscula or pore-areas, or to be otherwise important.

A considerable number of oscula occur scattered over the surface of the sponge. They are of greatly varying size, but all are quite small, the largest

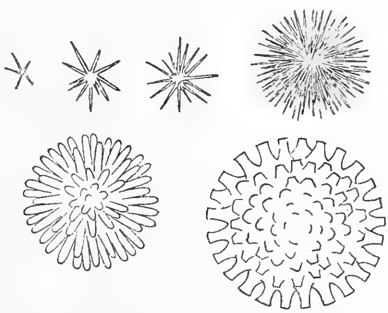


Fig. 4.—*Diastra sterrastræa*. Development of spherasters, ×700.

seen not exceeding 1·0 mm. in diameter. They are of very irregular shape, and hardly possess the usual characteristics of oscula. There is no oscular skeleton at all, nor can any oscular membrane be distinguished. They open directly, however, into the canal-system of the sponge.

The pores are scattered all over the sponge surface, and are not collected into pore-areas. They appear on the surface of the sponge as minute light spots, clearly showing up against the darker colour of the sponge. This is apparently a pore-membrane; and almost always in the centre of the light spot was a dark hole, undoubtedly the pore itself. In some of the pore-membranes no pore could be distinguished, presumably owing to its complete closure by the contraction of the membrane.

The colour in spirit is dark brown throughout the sponge.

The texture of the sponge is firm, but neither hard nor tough, nor is the sponge easily compressible. If bent out of its proper shape it immediately recovers it on being released.

The ectosome is differentiated into a cortex, which possesses a special skeleton in the form of a special layer of oxea in its deeper parts. The oxea

lie tangentially, but otherwise without orientation, and the layer is very dense. This spicular layer is about 0·2 mm. thick, and lies 0·5 mm. from the surface of the sponge.

Dermally also there is a dense surface-layer of small spherasters, among which considerable numbers of the large sterraster-like spherasters occur.

Below the cortex the skeleton is very scanty, consisting solely of somewhat sparsely scattered oxea, which lie in the sponge-body entirely without orientation and without relation to each other. Both small and large spherasters also occur throughout the sponge.

Spicules.

A. Megascleres.

The only megascleres occurring in the sponge are oxea, and only one kind of these is present. They form both the tangential cortical skeleton and the scattered spicules of the choanosome. They are usually quite straight and are thickest in the centre, tapering very gradually towards the ends for most of their length, and more rapidly at each end to a sharp point. The spicules vary very much in size, and spicules in all stages of growth can be found; the average full-grown specimen measures from 0·85 mm. to 1·0 mm. in length, with a maximum thickness of 0·016 mm.

Certain malformations and irregularities occur among these spicules. It is occasionally found that a spicule, instead of being quite straight, is distinctly bent, with a distinct angle at the centre. Again, there may be found, more rarely, specimens with one end abruptly rounded off, thus making the spicule apparently a style. These are, however, quite rare, and the presence of other malformations points to the conclusion that the rounded ends are accidental. The other malformations occur in the shape of extra actines, usually added near the end of the spicule, but sometimes one-fourth of the length of the spicule from its end. These supernumerary actines are usually very short, sometimes being merely a knob on the shaft of the spicule. The longest I have seen measured 0·05 mm. in length. They are all inclined to the ray at an angle of 35°–40°.

B. Microscleres. (Text-fig. 4.)

(α) Spherasters.

(i.) A large spheraster which, when fully grown, simulates a sterraster, occurs throughout the sponge-tissues, but most frequently in the superficial regions of the cortex. The smallest seen examples are typical oxyasters with 4 or 5 rays, and measuring 6·5 μ in diameter. Between these minute spicules and the fully-formed spheraster a complete series of intermediate forms occur, clearly showing the mode of growth of the spicule. The rays of the young aster grow in length and rapidly become very numerous,

the centrum being only represented by the fused ends of the rays. The largest specimen in which the actines retained their original sharply pointed condition was 0·17 mm. in diameter. The further growth takes place by elongation and thickening of the rays, but they do not seem to increase very much in number. In the fully-grown spicule the rays have developed slightly expanded heads, very similar to those of a true sterraster. The spicule never becomes absolutely solid, however, and the ends of the rays can always be distinguished, projecting from 3 to 5 μ from the central mass. The fully-grown spicule measures 0·36 mm. in diameter. There is no hilum such as is found in a typical sterraster.

In an account of the sponges of South-Western Australia, Hentschel (**15**) has described a species of *Stelletta* (*S. aurora*) which possesses somewhat similar spherasters to those of the species under consideration, especially in the variety *arenosa*: the rays are again numerous and are swollen and finger-like, but instead of the enlarged terminations which occur in *Diastra sterrastræa* the ends are provided with minute spines. Also the coalescence of the rays has not gone quite so far in *S. aurora* as in *Diastra sterrastræa*, but otherwise the spicules are very similar.

It is also noteworthy that in *Stelletta aurora* var. *arenosa* the heads of some of the triænes are evidently becoming obsolescent, so that there is considerable evidence furnished by these two species—*Stelletta aurora* and *Diastra sterrastræa*—of a direct descent of the family Epipolasidæ from the Stellettidæ.

(ii.) A small spheraster occurs scattered throughout the sponge, both cortex and choanosome, and forming a very dense dermal layer immediately beneath the surface. They consist of a comparatively large centrum, from which arise short knob-like rays. The size of the spherasters varies considerably, the largest being about 0·009 mm. in diameter.

Locality. The single specimen was obtained at Khor Dongonab.

Distribution. Red Sea.

Family TETHYIDÆ.

Astrotetraxonida with stylote megascleres and euasters for microscleres, with strongly developed fibrous cortex and radially arranged skeleton.

TETHYA SEYCHELLENSIS.

Synonymy:—

1881. *Alemo seychellensis*, Wright (**36**).
1884. *Tethya cliftoni* (Bow.), Ridley (**23**).
1888. *Tethya seychellensis*, Sollas (**29**).
1891. *Tethya seychellensis*, Keller (**18**).

There are three specimens in the collection. Two are rather small specimens, about 30 mm. in diameter. They each possess a single osculum,

situated, as in the specimens of *T. lyncurium*, at the summit of a very small papilla.

The sponge itself and the spicular measurements agree exactly with those described and figured by Keller (**18**).

A third specimen, which is dark brown in colour, has also been assigned to this species. It is very small indeed, being only 15 mm. in greatest diameter; and only a very few of the characteristic irregular, somewhat branched oxyasters were seen.

Locality. One specimen was obtained from the Etulah Shoals, Suez Bay; and two others from Khor Dongonab.

Distribution. Red Sea, Seychelles, Australia, Philippines, Brazil, Porto Rico.

TETHYA LYNCURIUM, *Linnæus.*

All the specimens obtained by Mr. Crossland, referable to this species, are small subspherical cushions attached to rock or coral by a large base. The largest is 30 mm. in diameter and about 25 mm. from base to summit. They each possess, exactly in the centre of the cushion, a small papilla, at the top of which occurs an osculum; and in no specimen could a second osculum be seen. The surface of the sponge is quite smooth, and the brush-like ends of the spicule-bundles show clearly. The colour in spirit is white.

The spiculation and spicule measurements agree exactly with those given by Dendy (**11**) for *T. lyncurium*, var. α, of the Ceylon Sponges. They also agree very closely with those of *T. seychellensis*, save that the irregular and sometimes branched oxyasters of the latter are lacking in these specimens.

Locality. Five specimens occur in the collection—one from Suez, the others from Tella Tella Kebira.

Distribution. Red Sea, Ceylon, North Atlantic, Porto Rico, Mediterranean.

Family SUBERITIDÆ.

Astrotetraxonida in which the megascleres are styli or tylostyli, and in which the microscleres have completely disappeared.

SUBERITES CARNOSUS, *Johnston.*

Synonymy:—

1842. *Suberites carnosus,* Johnston (**17**).
1900. *Suberites carnosus,* Topsent (**34**). With complete synonymy.
1891. *Suberites carnosus,* Keller (**18**).

Locality. Two specimens of this cosmopolitan species were obtained in Suakin Harbour. The larger measures 75 mm. × 55 mm.

Distribution. Red Sea, Atlantic Ocean, Mediterranean, Indian Ocean, Australia.

Laxosuberites sp.

A single very much dilapidated specimen, apparently belonging to this genus, was obtained.

Locality. Suez.

Pseudosuberites hyalinus (*Ridley & Dendy*).

Synonymy:—

1887. *Hymeniacidon hyalina*, Ridley & Dendy (**24**).
1900. *Pseudosuberites hyalinus*, Topsent (**34**). With complete synonymy.

A single very ragged specimen occurs in the collection which has been assigned to this species. The external form is not clearly apparent, owing to breaking of the specimen, but in general character it agrees very closely with *Pseudosuberites hyalinus* (*Hymeniacidon hyalina* of the 'Challenger' Report) except in the spiculation, the spicular measurements being much larger than those of *P. hyalinus* and more nearly corresponding with those of *P. sulphurea*, Tops. (**34**). The specimen has, however, been assigned to the former species on the grounds of general similarity.

Locality. The specimen was obtained on Suez mud-flats.

Distribution. Red Sea, Mediterranean, Patagonia.

Family Clionidæ.

Astrotetraxonida of boring habit, forming excavations in the shells of Mollusca and other calcareous bodies.

Cliona celata, *Grant*.

Synonymy:—

1826. *Cliona celata*, Grant (**14** *a*).
1900. *Cliona celata*, Topsent (**34**). With complete synonymy.
1909. *Cliona celata*, Hentschel (**15**).

The Clionids in the collection consist of four Lamellibranch shells, all more or less bored by the sponge. None of them show any growth of the sponge outside the shell.

It has therefore been decided to place them all in the species *C. celata*, with the spiculation of which they agree very well.

The shells are all *Margaritifera vulgaris*, save one, which is very much damaged by the *Cliona*, and unidentifiable.

Locality. Two specimens were obtained from Suez mud-flats and two from Khor Dongonab. Of these latter Mr. Crossland says in his notes:—

"The Clione forms a sheet on both surfaces of the shell, a state of things I do not remember seeing before. In this connection note that in many old pearl-shells the Clione destroys the outer part of the shell completely, but is

unable to penetrate the inner part and dies off. Many shells show that they were attacked badly some time previously and have recovered."

Distribution. Red Sea, Great Britain, Norway, Denmark, France, Mediterranean, Atlantic coasts of America, south coasts of Australia, New Guinea.

Sub-Order SIGMATOTETRAXONIDA, *Hentschel* * (**15**).

Tetraxonida in which the typical microsclere is a sigma or some form derived from it. True astrose microscleres are never found.

Family TETILLIDÆ.

Sigmatotetraxonida in which there are well-developed protriænes and a usually strongly radiate skeleton.

TETILLA POCULIFERA, *Dendy*.

Synonymy :—
1905. *Tetilla poculifera,* Dendy (**11**).

Six subspherical specimens of this sponge were obtained. They are all somewhat small, the largest being 26 mm. in diameter. They agree closely in all points with Professor Dendy's specimens from Ceylon, but the small oxea which occur throughout the choanosome are even more numerous than in his specimens, so that a section looks quite dark when examined owing to their enormous numbers.

All the specimens were obtained from Tella Tella Kebira.

Distribution. Red Sea, Ceylon.

PARATETILLA ECCENTRICA, n. sp. (Pl. **35**. fig. 1, Pl. **36**. fig. 8; Text-figs. 5, 6, 7.)

This species is represented by a single small specimen, of nearly spherical shape, but with the basal part missing. The surface of the sponge is very minutely hispid, the projecting spicules being few and small.

The specimen measures 21 mm. in diameter.

The oscula are irregularly scattered over the surface of the sponge, about a dozen in number, and measuring 1–2 mm. in diameter. An oscular membrane is usually visible, and the sides of the osculum are frequently sparsely coated with sand-grains. The pores were indistinguishable.

* Hentschel (**15**) gives no definite diagnosis to this sub-order, save to say that it comprises the Sigmatophora and Sigmatomonaxonellida of Dendy's classification (**11**). The above diagnosis, therefore, has been formulated to correspond with his diagnosis of the sub-order Astrotetraxonida.

The colour in spirit is grey-black on the surface. When cut or broken the cortex appears grey and the choanosome a dark brownish grey.

The ectosome (Pl. **36**. fig. 8) is differentiated into a distinct cortex, which varies in different parts of the specimen from 1·2 mm. to 1·4 mm. thick. In it occur the triænes, which are characteristic of the genus, and which in this species have undergone considerable malformation ; they lie quite irregularly, mixed up with the other spicules of the cortex.

The main skeleton is arranged radially and consists of large bundles spicules. In the deeper parts of the sponge these bundles are very dense, the spicules composing them being very closely bound together; but near the outer surface they become spread out into a fairly loose brush, so that there is no unprotected part of the sponge surface, owing to the overlapping of the brushes. These brushes are chiefly composed of oxea, but anatriænes and protriænes also occur in them. The protriænes are of considerable rarity, especially below the surface of the sponge. There is a special cortical skeleton consisting of a loose network of tangentially arranged oxea. These oxea are similar to those of the main skeleton, but do not reach quite so large a size.

In addition to the spicular bundles, the choanosome contains numbers of small oxea arranged very irregularly. The microscleres consist of sigmata, which occur in very large numbers throughout the choanosome, and rarely in the cortex.

Spicules.

A. Megascleres.

(α) Protriænes.

The protriænes of this species are few in number and inconspicuous. They are nearly always found with the heads projecting from the sponge surface. They consist of a long slender shaft, which frequently does not lie quite regularly in the spicular bundle, and a head composed of three small cladi, which are sometimes unequal or somewhat irregular. The shaft varies from 2·0 mm. to 2·5 mm. in length, and is of the same diameter for the greater part of its length. For the last half-millimetre of its length it tapers very gradually to a fine point, the most distal portions of the rhabdome being almost hair-like. The maximum diameter of the rhabdome is 0·005 mm. The cladi are short and usually bluntly pointed ; they vary considerably in length, from 0·008 mm. to 0·02 mm., and their diameter at the base is equal to that of the rhabdome. The expanse of the head varies with the length of the rays, being usually approximately equal to their length.

(β) Anatriænes.

The anatriænes are fairly numerous ; a few of them have their heads projecting from the surface of the sponge, but by far the larger number do not project. The heads of these non-projecting spicules almost invariably lie in

the cortex, it being very rare to find a head in the choanosome. The rhabdomes are similar to those of the protriænes, but even longer, and they frequently possess a swelling just below the head. The length of the rhabdome varies from 2·5 mm. to 3·6 mm.; it is very slender, rarely exceeding 0·004 mm. in diameter, and frequently does not measure more than 0·0025 mm. The swelling below the head, when present, usually occurs about 0·013 mm. down the shaft, and is about 0·006 mm. to 0·01 mm. in diameter. The cladi composing the head are rather short and slender; they are straight in their distal portions, which make an angle of about 60° with the rhabdome. They are usually obtusely pointed. Their average length is about 0·02 mm. to 0·026 mm. and their diameter 0·003 mm. at the base; the sagitta of the head is 0·02 mm. to 0·025 mm., and the chord 0·042 mm. in full-grown specimens.

Like the protriænes, the anatriænes do not always lie regularly in the spicular bundle, their extreme length in proportion to their thickness rendering them specially flexible. They are frequently found outside any spicule-fibre for a portion of their length.

(γ) Cortical triænes. (Text-figs. 5 & 6.)

The cortical triænes, which are characteristic of the species, are extremely irregular, and present extraordinary modifications and abortions. One or more of the rays may be greatly stunted, or even entirely absent, or they may be greatly prolonged, abruptly bent at sharp angles, covered with knobs and excrescences, or even branched.

They do not occur in large numbers, and are entirely confined to the cortex. They are arranged quite irregularly, both as to frequency and orientation.

Two main types of malformation can be distinguished. In the first (text-fig. 5) all four actines can be distinguished, though one or two of them are frequently dwarfed, being sometimes only represented by knobs. The angles at which the rays meet vary very much, and the rays are sometimes all in one plane, but it is usually possible to recognise the spicule as a true triæne.

The other type (text-fig. 6) usually only possesses two of the four actines, though sometimes one or both of the others are present. One ray is long, more or less regular and straight, and usually pointed. The other ray (or rays) are dwarfed, and nearly always covered with knobs or protuberances, and form a kind of head to the spicule. The whole spicule may, in fact, be compared to a "freak" walking-stick. The head nearly always forms a right angle with the long ray. The whole spicule bears a striking resemblance to walking-sticks.

It must be noted, however, that no hard-and-fast line can be drawn between the two types as described above, though they are separated for

purposes of description. Many of the spicules would go almost equally well into either, such as those in which the "walking-stick head" is formed of more than one ray.

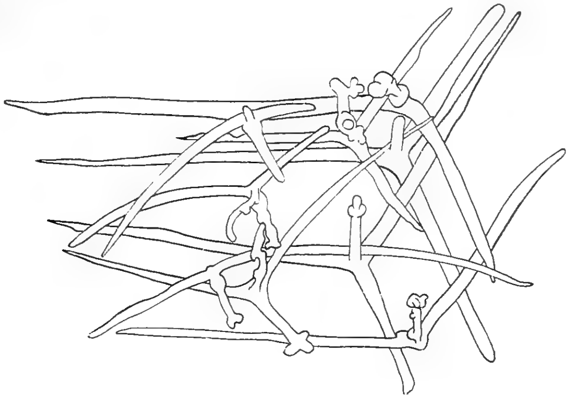


Fig. 5.—*Paratetilla eccentrica*. Cortical triænes, × 250.

Others, again, do not come under either of these groups. Sometimes spicules can be found with a "head" at each end of the long ray ; sometimes

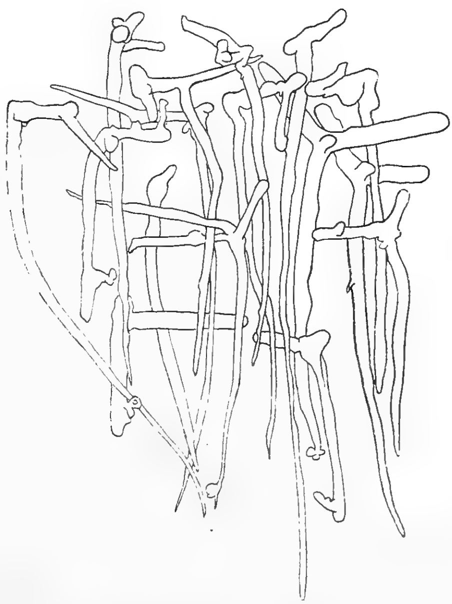


Fig. 6.—*Paratetilla eccentrica*. Cortical "walking-stick" triænes, × 250.

all four actines are dwarfed and bulbous ; sometimes the spicule is reduced to two short rays, more or less malformed ; or it may even be represented by a single ray. It is worthy of note, however, that those rays which are

elongated are almost never covered with excrescences, nor otherwise grotesquely malformed.

The measurements of these spicules vary extremely, so that average lengths are quite impossible to give. The longest rays do not seem to exceed 0·26 mm. in length, or 0·012 mm. to 0·014 in thickness. Dwarfed rays, however, seem to grow much thicker than the elongated ones as a general rule. They frequently measure 0·02 mm. in diameter across the ray itself, or, including the excrescences, anything up to 0·03 mm. or even 0·035 mm. These measurements, however, are quite probably exceeded in other spicules, as there does not seem to be any reason why the growth of these excrescences should be limited to these dimensions.

Abnormal triænes also occur in *Pachastrella abyssi*, Sollas (**29**).

(δ) Oxea.

(i.) The oxea of the main skeleton are long and fairly stout. They are pointed at both ends, and the thickest point is in the middle of the spicule length, from which there is a gradual tapering towards either end. They measure from 2 mm. to 3 mm. in length, and from 0·01 to 0·015 mm. in diameter at the thickest part. These spicules form the greater part of the spicular bundles and always lie very strictly radially. They form a large proportion of those spicules which project from the surface of the sponge.

(ii.) The tangential cortical oxea are straight, rather slender oxea, which do not reach so great a length as do the oxea of the main skeleton. They are sharply pointed at both ends and measure 0·8 mm. to 1·4 mm. in length. Their thickness does not exceed 0·008 mm.

B. Microscleres. (Text-fig. 7.)

(α) The somal microxea lie irregularly scattered throughout the choanosome and very occasionally in the cortex. They are slender and sometimes almost raphide-like. They measure 0·15 mm. in length by 0·002 mm. in diameter.

Fig. 7.—*Paratetilla eccentrica*. Microscleres, × 350.

It is somewhat doubtful whether these spicules should be described as megascleres or microscleres, but I follow Dendy (**11**) and Sollas (**29**), who have previously described these spicules as microscleres in other species.

(β) The only microscleres which occur in this species in addition to the small somal oxea are very small sigmata, which occur in very large numbers throughout the choanosome. They possess the characteristic **S**- or **C**-shape of all the sigmata found among the Tetillidæ, and measure about 0·01 mm. to 0·02 mm. across. Their diameter does not exceed 0·001 mm.

The present species forms the third known species in this somewhat

remarkable genus, the two previous species being *P. merguiensis*, Carter (7), and *P. cineriformis*, Dendy (11). All three species come from the Indian Ocean or adjacent waters: *P. cineriformis* was obtained in Ceylon and *P. merguiensis* at various localities from Mergui Archipelago to Torres Strait.

These three species form a complete series illustrating the development of the cortical triænes. In *P. merguiensis* the spicule can be clearly seen to be developed from an ordinary plagiotriæne, since the rhabdome can always be distinguished from the cladi in them. Further, young forms can be found in which the plagiotriæne form is not obscured. A considerable advance is seen in *P. cineriformis*, where the true triæne form is entirely lost and the spicule is somewhat irregular. The triænes are, in fact, very similar to those of *P. eccentrica* which possess all four rays. A further advance is seen in *P. eccentrica*, where, as described above, some of the triænes have become modified into "walking-sticks." Otherwise these two species are very similar, both in shape, colour, and skeleton.

The genus is especially interesting as indicating a possible origin for the Lithistida. The appearance of two main types of triænes in *P. eccentrica* also suggests that the Tetracrepid Lithistida and the Monocrepid Lithistida may have arisen from the same group, by selective specialism, from some such form as this, where spicules bearing a resemblance to desmas of both kinds occur.

The evidence which can be brought forward in favour of a Tetillid ancestry for the Lithistida is, however, far too vague to enable one to do more than point out the possibilities suggested by the various species.

Locality. The single specimen was obtained at Tella Tella Kebira.

Distribution. Red Sea.

CHROTELLA IBIS, n. sp. (Pl. **35.** fig. 2, Pl. **36.** fig. 7; Text-fig. 8.)

This species is represented in the collection by several specimens, all very similar in appearance. Each consists of a subspherical mass, in the largest specimen 23 mm. in diameter. The basal portion of the sponge is wanting in all the specimens, probably being left on the support when the sponge was collected. The broken surface forms a large, more or less flat area, the diameter of which is very nearly as great as that of the sponge at its thickest point, so that if this area really represents the approximate area of attachment, the sponge will have the shape of a somewhat globose cushion.

The surface is densely but minutely hispid, but the greater part of the projecting spicules are broken off close to the surface of the sponge. Immediately covering the surface is a single compact layer of sand-grains, entangled among the projecting spicules.

There are several small oscula visible on each of the specimens, measuring

about 0·75 mm. in diameter and scattered over the sponge surface quite irregularly. The pores were not distinguishable.

The colour in spirit is yellowish to dull yellow-brown.

The ectosome is quite clearly marked off from the choanosome; it is perfectly hyaline in appearance and no cell-elements could be found in it. The average thickness of the ectosome is 0·5 mm. There is no special cortical skeleton whatsoever, unless the layer of sand-grains referred to above is considered to fall under this head.

The skeleton is radial, and most of the spicules are arranged in rather loose bundles, though many spicules occur lying free in the choanosome between the spicule bundles.

In the deeper parts of the sponge the spicule bundles are fairly compact, but the spicules are quite separate in the outer regions of the sponge. When the actual surface of the sponge is reached, the spicule bundle is expanded into a brush-like head, and the spicules of adjacent bundles become intermingled. Thus the whole surface of the sponge is covered by an even coat of spicule heads. These spicular bundles measure from 0·12 mm. to 0·14 mm. in diameter when the spicules composing them are close together, as they are near the centre of the sponge. The whole of the spicules in the main skeleton in the deeper parts of the sponge are oxea, the anatriænes and protriænes being confined to the superficial parts; in fact, it is quite rare to find a triæne head more than 2 mm. from the sponge surface.

Scattered about through the choanosome occur large numbers of small oxea, closely resembling those of *Tetilla poculifera*, Dendy, referred to above.

There are now, in fact, six species of Tetillidæ in which these microxea occur now known to science, namely: *Tetilla australiensis*, in which they are minutely spined, and *Tetilla poculifera*, *Chrotella ibis*, and all the three species of *Paratetilla* at present described, *P. merguiensis* (Carter), *P. cineriformis*, and *P. eccentrica*, in all of which they are smooth. It is also noteworthy that in two species—*Tetilla poculifera* and the species at present being described, *Chrotella ibis*—they occur in enormous numbers, so that the colour of the specimen is noticeably affected. In the present species they do not occur so thickly as in *Tetilla poculifera*, but nevertheless they form a conspicuous part of the whole skeleton. They are entirely confined to the choanosome, the cortex being absolutely free from them.

Spicules.

A. Megascleres.

(α) Triænes. (Text-fig. 8.)

Triænes are present in considerable numbers in the sponge. They form a very considerable proportion of the spicules projecting from the sponge surface, and although these projecting spicules are very frequently broken

off, so that the triæne head is not present, yet they can always be distinguished from the oxea by the much more slender rhabdome. Both anatriænes and protriænes occur in this species, and both kinds occur with their heads both projecting from and buried in the sponge. Of those projecting from the sponge it is impossible to determine the proportions in which the two kinds of spicules occur, owing to the breaking off of the triæne-heads referred to above ; but of those which still retain their cladi, the anatriænes are much the more plentiful, both outside and inside the sponge.

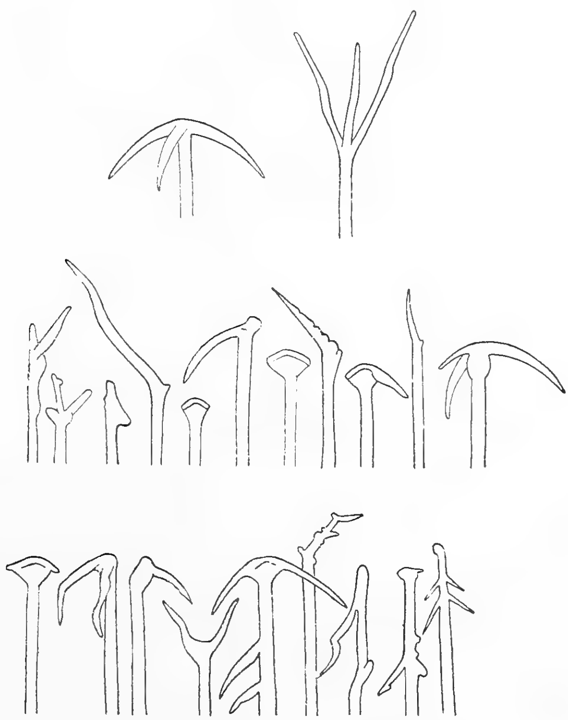


Fig. 8.—*Chrotella ibis.* Triænes, × 30.

The two spicules on the top line are the normal type of spicule; those in the second row are abnormal forms, the heads of which protruded from the sponge surface; the third row contains similar abnormal forms which were entirely embedded in the sponge tissue.

The most characteristic feature of these spicules is the constant malformation of the heads, in both kinds, so that the cladi are frequently reduced in number, and those that are present of unequal length, or the whole head may be reduced to a knob. In addition extra cladi may occur on the rhabdome, as many as five such being seen in one case ; spicules bearing these extra cladi have not, however, been seen outside the sponge. Both these cladi and

the cladi of the regular head are frequently malformed, with knobs and small excrescences growing on them. In exceptional cases the cladus may be bent at a sharp angle part way along its length. Examples of these malformations are shown in text-fig. 8, the two spicules at the top of the figure being normal perfect examples, those in the second row malformed spicules projecting from the sponge surface, and those in the lowest row similar spicules whose heads were buried in the sponge-body. The rhabdomes of both anatriænes and protriænes are very slender and flexible, and frequently do not lie parallel with the oxea, but sinuously in the sponge.

The *protriænes* are somewhat few in number, especially with their heads inside the sponge-body, and almost all of them are very much malformed. In fact, only a single specimen was seen in which all three rays were present and well developed. The length of the rhabdome varies very much, and specimens may be found with the rhabdome anything up to 1·5 mm. in length. It is, of course, quite possible that the broken spicules measured much more than this when complete. The thickness of the rhabdome is 0·005 mm. in the largest specimens at the head, and the rhabdome tapers from this point gradually to an extremely fine point. The cladi naturally vary very much in length, the longest cladus found being 0·084 mm. The chord of the head also varies with the length of the cladi and the amount of malformation the head has undergone, and no average measurements can be given.

The *anatriænes*, which are fairly plentiful, possess a rhabdome very similar to that of the protriænes. It varies considerably in length, some specimens being found to attain a length of 2·1 mm. The diameter is greatest close to the head, where it measures 0·004 mm., and from this point the rhabdome gradually tapers to the point. It is almost impossible to give measurements for the head, owing to the malformations which occur, but the following are taken from a complete and normal specimen :—

Cladi 0·043 mm. in length, 0·006 mm. in diameter at the base.
Sagitta 0·035 mm.
Chord 0·06 mm.

One of the most frequent malformations, that in which the head is reduced to a knob, seems to be confined entirely to anatriænes. This knob usually measures from 0·013 to 0·018 in diameter.

(β) Oxea.

(i.) The oxea of the main skeleton are long, pointed at both ends, and much stouter than the triænes. They are thickest in the middle of their length, and taper gradually and uniformly to each end. Those oxea which have one end projecting from the surface of the sponge are practically all broken, so that their length cannot be ascertained, but there does not seem any reason for

supposing them different to the spicules of the interior of the sponge. These have a maximum length of 1·6 mm. and a diameter of 0·025 mm. at their thickest point.

(ii.) The small choanosomal oxea are short and very slender. They lie irregularly throughout the choanosome and are quite unoriented. They do not seem to occur more thickly in one part of the sponge than another. They measure 0·15 mm. in length, by 0·021 mm. in diameter.

B. Microscleres.

The only microscleres found in this species are small delicate sigmata of typical shape. They occur profusely scattered throughout the choanosome, and in somewhat less numbers in the ectosome. They measure 0·01 mm. to 0·015 mm. across the curve.

Locality. All the specimens were obtained at Tella Tella Kebira.

Distribution. Red Sea.

Family HAPLOSCLERIDÆ.

Sigmatotetraxonida in which microscleres, when present, are usually in the form of sigmata or derivations thereof, but never chelæ. The skeleton is reticulate and the fibre is typically non-plumose. The megascleres are all monaxonid and usually diactinal.

Sub-Family RENIERINÆ.

Haploscleridæ in which the microscleres have entirely disappeared and the skeleton consists of a reticulation of oxeote megascleres with little or no spongin.

RENIERA IMPLEXA, *O. Schmidt.*

Synonymy:—

1870. *Reniera implexa*, O. Schmidt (**25**).
1886. *Reniera implexa*, Ridley & Dendy (**24**).
1904. *Reniera implexa*, Topsent (**33**).
1905. *Reniera implexa*, Dendy (**11**).

A few broken cylindrical tubes occur in the collection, which agree very well with Schmidt's (**25**) description, both as to external form and appearance and in their spiculation.

Locality. No definite locality is given. The bottle is labelled "Sponge Trials 1."

Distribution. Red Sea, Ceylon, Adriatic, Azores.

Reniera tabernacula, n. sp. (Text-fig. 9.)

This species is represented by a single, apparently complete specimen of nearly triangular shape. The sponge measures 55 mm. in its greatest length and is 22 mm. wide. It is flattened and, in fact, nearly lamellar, being only 7–8 mm. in thickness. The specimen is quite unattached to any support, but on one of the two triangular surfaces (presumably the lower) there is a deep oval hollow, extending almost through the whole thickness of the sponge, from which the original support of the sponge has presumably been detached. From the shape of the cavity this support seems to have very possibly been a crab.

The surface of the sponge is devoid of fistulæ or outgrowths, but nevertheless it is not quite smooth, owing to the projection of the ends of the spicular fibres slightly from it. The dermal membrane is almost entirely absent, but the small portion remaining is quite smooth between the projecting fibres of spicules, and pierced with very numerous pores. The rest of the sponge surface is regularly reticulate, with a number of small holes in each mesh. Whether these are oscula or inhalant canals cannot be ascertained, as the dermal membrane is absent.

The colour in spirit is yellowish white.

The texture of the sponge is tough, but very easily compressible.

The skeleton is of a typical Renierine type, and possesses a large number of very clearly marked main fibres, whose direction is radial and whose ends project from the surface of the sponge. Owing to the lamellar character of the sponge, however, the radial direction of the fibres has become modified in the central parts of the sponge so that they run from the base to the upper surface of the sponge, directly perpendicular to both surfaces. These fibres are densely spicular, the spicules in them being frequently 6–10-serial; they lie rather irregularly in the sponge, and the distance between them varies considerably, especially in the deeper parts of the specimen. At the surface they are more regular in arrangement, and the average distance between them is 0·15 mm., or rather more than the length of the individual spicules. Many of them branch, and a very few anastomoses between main fibres were observed.

Fig. 9. — *Reniera tabernacula.* Spicules, ×235.

Connecting fibres, lying tangentially in the sponge, and exactly similar to the main fibres in structure and size, occur occasionally, but the greater part of the skeleton network is formed of a regular reticulation of uniserial secondary fibres, which form a rectangular mesh, each side of which is composed of a single spicule.

There is no dermal skeleton distinct from the above-described secondary fibres.

The spicules are cylindrical, usually very slightly curved, and abruptly pointed at each end. They measure 0·11 mm. long in the secondary fibre, and slightly more (0·12 mm. to 0·14 mm.) in the main fibres. The average diameter is 0·0035 mm.

Locality. Agig Harbour.

Distribution. Red Sea.

RENIERA SPINOSELLA, n. sp. (Text-fig. 10.)

This new species is represented by several specimens, none of which is large. All the specimens consist of an irregularly shaped mass of conical processes, each of which bears an osculum at the top. There is, however, a very considerable variation in the amount of fusion which these processes have undergone, as in some cases they are completely separate and in some they are almost completely fused, so that the whole specimen looks like an irregular mass with some slight rounded swellings over it. The largest specimen measures 55 mm. by 40 mm., and is 27 mm. high. The average diameter of the conical processes is 15 mm.

All the specimens are growing amongst seaweed, and in some cases the seaweed has been enclosed within the sponge tissues.

The surface of the sponge is typically covered with small processes scattered irregularly over the whole of the specimen. In the specimen in which they are developed to their greatest extent they are on the average 2 mm. high, and do not stand erect, but lie decumbent on the surface of the sponge. In other specimens they are shorter and more or less upright, but they are always very lax and easily bent. In one specimen these small processes are entirely absent and the surface quite smooth. The skeleton in this specimen is, however, exactly like that of the others, and it is quite impossible to separate this specimen from the others specifically.

The surface is covered with a very delicate dermal membrane, which has no special skeleton.

The oscula are confined to the summit of the large conical processes, each of these processes possessing a single osculum, which varies in diameter in different examples from 1 mm. to 2 mm. The pores could not be distinguished.

The colour of the sponge is dirty grey.

The texture is lax and very easily compressible, but not fragile, however, and not easily torn.

Skeleton arrangement.

The skeleton consists of a reticulation of spicules, with a few spicular fibres here and there. These primary fibres usually contain from three to five rows of spicules, and in rare cases six or eight. The primary fibres themselves are very few in number, and are wholly absent from some parts

of the sponge. They run quite regularly radially in the sponge, and frequently pass out into the small processes above described. The rest of the skeleton is wholly unispicular, and the sides of the mesh usually consist each of a single spicule. The reticulation thus formed is quite regular in most parts of the specimen, but at the points of fusion of the large processes of which the sponge is composed they become more or less irregular.

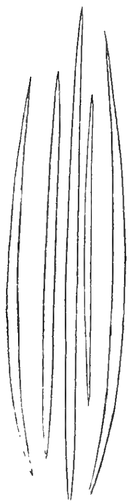


Fig. 10.—*Reniera spinosella*. Spicules, ×500.

Spicules.

The only spicules which occur in this species are oxea; they are sometimes slightly curved, but usually quite straight and cylindrical. They are usually tapering throughout their length, but occasionally spicules may be found of the same diameter for the greater part of their length, and are abruptly pointed at each end. They measure 0·13 mm. in length and 0·005 mm. in diameter.

Locality. The whole of the specimens were obtained in Suez Docks, "from beneath a floating stage, which had been in the docks for several years."

Distribution. Red Sea.

Reniera sp.

A small, somewhat triangular fragment, apparently broken off from a lamellar sponge. The fragment is 5 mm. thick, and measures 25 mm. long by 15 mm. wide at the widest part. The broken surface extends around two sides of the triangle, the third (and shortest) side being the external edge of the sponge.

The skeleton arrangement is very regular, consisting of a rectangular meshwork, each of the sides of each mesh being composed typically of a single spicule, so that the diameter of the mesh is the same as the length of the spicules.

A few spicular fibres can be distinguished here and there in the sponge, but they do not seem to lie in any particular direction, and they very rarely indeed contain more than two rows of spicules, and never more than three.

The dermal membrane is supported by a reticulation of spicules, but neither the size of the mesh nor that of the spicules differs at all from those of the main skeleton.

The spicules are oxea, and as a rule quite straight, though a few were seen

that were slightly curved. They are of the same diameter throughout the greater part of their length, and taper abruptly to a sharp point at each end. They measure 0·13 mm. in length and 0·005 mm. in thickness.

Locality. Agig Harbour.

Distribution. Red Sea.

HALICHONDRIA BUBASTES, n. sp. (Text-fig. 11.)

A single large specimen of this new species occurs in the collection. It is massive and irregular in shape, and possesses several very irregular shallow fistulæ arising from it. It measures 75 mm. × 55 mm., and is 40 mm. high, including the fistulæ. On the summits of most of these fistulæ are the oscula, which are large and possess a distinct oscular lip. They vary in size from 2 mm. to 5 mm. in diameter. The pores could not be distinguished.

This external form is noteworthy as being identical with that of *Trachyopsis halichondrioides*, Dendy (**11**), specimens of which also occur in the Red Sea. Its spiculation is, however, quite different to that of *Trachyopsis*.

The surface of the sponge is not reticulate, but quite even and regular; it is, however, very minutely hispid through the slight projection of spicules from it.

The sponge is soft and very easily compressible, but when whole is firm and elastic, though in spirit the interior of the sponge is friable and easily breaks.

The colour is similar to that of sand.

The skeleton arrangement is very irregular, and consists of a very ill-defined network of spicular fibre and scattered spicules. The number of spicules which lie scattered singly, or in twos and threes, about the sponge is very large, and they render the skeleton arrangement very similar to that of *Reniera* at first sight; but since this arrangement varies in different parts of the sponge, both as to the regularity of the network and the size of the mesh, and since the size of the spicules is also very variable indeed, I have come to the conclusion that the apparent regularity of the skeleton arrangement in some parts of the sponge is only accidental, and I have therefore placed the species in *Halichondria* rather than in *Reniera*.

The spicular fibres, where they occur, vary very greatly in the number of spicules they contain, and also in the closeness with which their spicules are bound together. They cannot, however, be divided into primary and secondary fibres, nor do they have any definite direction in the sponge. The spicules composing them vary in number from 1- to 20-serial, and fibres of all intermediate sizes may be found.

Spicules. (Text-fig. 11.)

Fig. 11.—*Halichondria bubastes.* Spicules, ×500.

The only spicules occurring in the sponge are oxea, and, though they vary very greatly both in length and diameter, there cannot be drawn any line of demarcation between the various forms. In this respect (though not in actual size) the spicules of *H. bubastes* are very like those of *H. panicea*, but the external surface of the two species is very different. As a general rule, the oxea are quite straight, but some of them are slightly curved, and when this is the case the curvature is always regular and extends throughout the length of the spicule. The spicules vary from 0·06 mm. to 0·13 mm. or even more, and in diameter from 0·001 mm. to 0·005 mm.

The above species is a somewhat unsatisfactory one. The characters on which it is founded are, as in the case of so many *Halichondrias*, of a very indefinite nature, and no characteristic shape, or size, or skeleton can be assigned to it. It does not seem to go into any of the previously named species very easily, however, and I have thought it better to add to the number of species in this already very confusing genus rather than assign it to any species not thoroughly agreeing with it.

Halichondria sp.

Three masses of calcareous worm-tubes were obtained, which are surrounded by an irregular sponge belonging to this genus. The sponge also fills up all the spaces between the tubes. All three specimens were obtained together, and are probably fragments torn away from some large sponge. Neither of the three specimens shows any part of the external surface of the sponge, so specific identification is impossible.

The skeleton consists of an irregular reticulation of spicular fibre and scattered spicules. In the fibres the spicules vary considerably in number and lie somewhat irregularly. The fibres possess from 3 to 8 rows of spicules.

The spicules are oxea, which are frequently slightly curved, and which vary tremendously in length, any size up to 0·13 being found. They are thickest about the middle of their length, and have a maximum diameter of 0·005 mm.

Locality. Not stated.

Distribution. Red Sea.

TRACHYOPSIS HALICHONDRIOIDES, *Dendy*.

Synonymy :—
1904. *Trachyopsis halichondrioides,* Dendy (**11**).

This species, previously only recorded from Ceylon, is represented in the collection by several large specimens, some of which are considerably larger than the type specimen. The general character of the specimens is, however, exactly that assigned to this species in Dendy's original description, the sponge being large, massive, and irregular, with irregular, more or less conical projections here and there on its surface, each of which possesses an osculum at its summit.

The largest specimen forms an irregular mass 100 mm. long by 55 mm. broad. Its thickness varies in different parts from 10 mm. to 25 mm.

The skeleton arrangement is even denser than in Dendy's specimen, and the dermal spicular brushes, which are characteristic of the genus, are very well marked. The spicules vary enormously in length, and specimens of all sizes are mixed up together, the smaller specimens being apparently young spicules in process of formation. The length of full-grown specimens is about 0·6 mm.

Locality. No locality for these specimens was given, the bottle containing them being labelled merely " Sponge Trials 1."

Distribution. Red Sea, Ceylon.

Sub-Family CHALININÆ.

Haploscleridæ without microscleres and with diactinal megascleres. Skeleton a network of more or less strongly developed horny fibre covered by megascleres.

PACHYCHALINA VARIABILIS, *Dendy*.

Synonymy :—
1890. *Pachychalina variabilis,* Dendy (**8**).

This species is represented in the collection by a single large specimen composed of a number of irregular lobes and branches, which grow erect and arise from a rather small base. The whole sponge presents an exactly similar appearance to that shown in Dendy's (**11**) figure of this species. There does not seem to be any real difference between the cylindrical branches and the large lobes which occur here and there in the specimen ; the lobes may arise by the enlargement of branches, and branches may grow out of these lobes. In one place the sponge has formed a fairly large irregular covering around

a horny lamellibranch shell (? *Avicula*), and from this mass other branches arise.

The whole specimen stands 160 mm. high from base to summit; the branches vary from 10 mm. to 20 mm. in diameter, and the lobes are about 20 mm. in thickness at their thickest point.

The oscula are fairly numerous and are scattered irregularly over the whole surface of the sponge. They are not of great size, averaging 3 mm. in diameter. The pores are very numerous, of comparatively large size, and are scattered thickly over the whole of the dermal membrane.

The colour in spirit is dark brown.

The texture of the sponge is firm and resistant, but easily compressible.

The skeleton consists of an irregular network of spicular fibre, the spicules of which are cemented together by spongin. As a rule, a series of radial primary fibres can be distinguished, but in some parts of the sponge no distinction can be drawn between the primary and secondary fibres. The secondary fibres uniting the primary fibres form a very irregular reticulation, and possess no definite arrangement whatever. The mesh is very variable in size, but on the average is between 0·5 mm. and 0·6 mm. in diameter. The meshes are quite irregular in shape.

The primary fibres possess sometimes as many as 10 rows of spicules, and usually 7 or 8 rows. In the secondary fibres the spicules rarely lie more than 2–3-serial, though fibres intermediate between primary and secondary may be found in some parts with 5–8 rows of spicules. The spongin coating the spicules is somewhat scanty and only just shows outside the fibres. The dermal membrane is supported by an extremely fine fibre-network, in which the spicules rarely lie more than 2-serial, and the meshes of which are very fine.

Outside these fibres a very few oxea can be found lying in the sponge substance without any orientation. They are exactly similar to those of the fibres.

The spicules are almost wholly diactinal, but a very few styles may be found occasionally intermingled with the oxea. They are certainly only accidental malformations of the typical spicules, and not true styles.

The oxea are fairly large, reaching 0·16 mm. in length by 0·004 mm. in diameter. These measurements are slightly larger than those given by Dendy for this species in the type specimens from the West Indies, but otherwise the two specimens are extremely similar. Dendy's measurements are: length 0·126 mm., diameter 0·003 mm.

Locality. No definite locality is given for this sponge, but merely "Sponge Trials 1."

Distribution. Red Sea, West Indies.

CHALINA MINOR, n. sp. (Text-fig. 12.)

This new species has been created for the reception of two small specimens.

The first specimen is of irregularly ovoid shape and shelters a small crab. The complete specimen measures 28 mm. long by 19 mm. wide, and is 19 mm. high at the highest point.

The second specimen does not shelter a crab, but there is on one side a shallow oval depression, from which it seems likely that a crab has been detached. The specimen is an upright mass, somewhat larger than the previous one, and measures 30 mm. by 35 mm., and is 32 mm. high. All over the surface of the sponge, except the depression supposed to have been occupied by a crab, there occur irregular and rather large fragments of calcareous matter and rock (average size 5 mm. × 5 mm.), some of which are merely attached to the surface, while others are actually partially embedded in the sponge.

The true surface of the sponge is wanting in both specimens, the dermal membrane having been entirely destroyed all over the specimen. As a result, the surface appears finely reticulate, as the skeletal fibres are apparent. This reticulation varies in the size of the mesh from 0·1 mm. to 1·0 mm.

The oscula and pores were neither visible, doubtless owing to the destruction of the dermal membrane.

The colour in spirit is a rather dirty yellowish white.

The texture of the sponge is soft and easily compressible, but nevertheless tough and not easily broken.

Skeleton arrangement.

The skeleton consists of a fairly regular reticulation of spicule-covered spongin-fibre, in which primary and secondary fibres are clearly differentiated.

The primary fibres run radially, as a rule about 1·0 mm. apart, though in some parts of the sponge they lie more irregularly, sometimes close together, and in other places much more rarely. They always contain several rows of spicules, usually 5 or 6. These spicules are arranged in a somewhat plumose manner in the fibres, so that their outer points extend frequently almost to the surface of the fibre. The fibres measure 0·06 mm. in diameter.

In the secondary fibres the spicules always lie uniserially, and there are frequently short gaps between the ends of the spicules in the fibre. The fibres do not possess any definite orientation, but form a fairly regular network which varies in size of mesh from 0·2 mm. to 1·0 mm. The fibres measure, on the average, 0·004 mm., some being as small as 0·03 mm., while a few may be found as large as 0·06 mm.

Fig. 12.—*Chalina minor*. Spicules, ×400.

Spicules. (Text-fig. 12.)

The spicules of this species consist solely of oxea, which are nearly always curved, cylindrical oxea, tapering from the middle to either end. The ends are sharply pointed. The average length of the spicules is 0·09 mm.

Spongin.

The spongin coating the spicules is very pale in colour, and not very abundant in the main fibres. In actual size the secondary fibres sometimes quite equal the primary fibres, though they contain many less spicules.

Locality. From Suakin Harbour, in 5 fathoms of water.
Distribution. Red Sea,

Ceraochalina densa, *Keller*.

Synonymy:—
1889. *Ceraochalina densa,* Keller (**18**).

Two specimens occur in the collection belonging to this species; they are large spreading sponges, not rising very high from their support, and they bear a number of large, low tubes, partially fused together where their sides come in contact, which form the major portion of the specimens. These tubes are about 25 mm. high from base to summit, and 60 mm. in diameter in the largest specimens. The whole sponge forms a low cushion.

The skeleton, both in structure and measurements, and the spicules occurring in it, agree very closely with Keller's descriptions.
Locality. Suakin Harbour.
Distribution. Red Sea.

Siphonochalina conica (*Keller*).

Synonymy:—
1889. *Phylosiphonia conica,* Keller (**18**).

Several specimens of this species occur in the collection. The largest forms an irregular spreading mass covering a large base, with several tubular processes arising from it. Another specimen is growing over a group of mussels, and others have mussels embedded in them. In all a very great similarity of form is apparent, and the tubular processes which arise from them are very similar. From the largest specimen 12 of these tubes arise, which are 15 mm. high and 8 mm. in diameter at the base. At the summit the diameter of the tube is only 6 mm., and here the sponge-wall merely consists of the oscular lip, the osculum being as wide as the tube itself in this

region. Throughout the length of the process the wall of the tube is very thin and rarely exceeds 3 mm. in thickness.

The colour in spirit is dirty white.

The skeleton arrangement and the spicular measurements agree with Keller's description.

Locality. All the specimens were obtained from buoys in Suez Bay.

Distribution. Red Sea.

SIPHONOCHALINA COMMUNIS, *Carter.*

Synonymy:—

1880. *Siphonochalina communis,* Carter (**7** *a*).

1905. *Siphonochalina communis,* Dendy (**11**).

This species is represented in the collection by three specimens representing two varieties.

Var. α.—The first variety is represented by two fairly large specimens, the largest possessing five tubular processes 20–25 mm. in diameter. They agree very closely with Dendy's figure in the report on the Ceylon Sponges (**11**). The tubular processes are quite smooth on the surface, but they exhibit a very slightly raised and rather inconspicuous reticulation on the surface, as do Dendy's specimens. At the summit of each of the tubes is an osculum whose diameter is on the average 4 mm.

The colour of the specimens is yellowish white.

The skeleton consists of an irregular reticulation of spicule-covered spongin-fibres, in which main fibres can be distinguished from secondary fibres, for the main fibres, which run somewhat irregularly, are covered by several rows of spicules, while the secondary fibres have the spines arranged uniserially.

The spicules are oxea, straight, smooth, and cylindrical. They are of the same diameter for the greater part of their length, and abruptly but sharply pointed at each end. They measure 0·1 mm. in length and 0·002 in diameter.

Var. β.—The second variety is represented by a single specimen, consisting of two tubes only. These tubes are somewhat low, not being more than 12 mm. in height, but are of distinctly larger size than those of var. α, the largest measuring 33 mm. in diameter. The second tube is a small one, arising as an offshoot from the first, and measures 15 mm. in diameter. They each possess a widely open osculum at the summit, the diameter of the oscula being 8 mm. in the case of the larger tube and 4 mm. in the case of the smaller tube.

The surface of this specimen is even smoother than that of the two previous, there being no reticulation visible in this case.

The colour in spirit is dark brown.

The skeleton is very similar to that of var. α, but the main fibres run more regularly and do not contain quite so many spicules.

Locality. Two specimens were obtained from the mud-flats at Suez, and the third from Suez Docks.

Distribution. Red Sea, Kurrachee, Ceylon, Port Jackson.

Siphonochalina tubulosa, *Ridley.*

Synonymy:—

1884. *Siphonochalina tubulosa,* Ridley (**23**).
1887. *Phylosiphonia pumila,* Lendenfeld (**19**).
1889. *Phylosiphonia pumila,* Keller (**18**).

This species is represented by a considerable number of specimens, all of which are small. The largest possesses five tubes arising from a flat spreading base. The whole specimen measures 70 mm. by 60 mm.; the tubes are 25 mm. high and 12 mm. to 15 mm. in diameter. At the top of each tube is a large osculum 6 mm. to 7 mm. across.

The colour in spirit is yellowish white.

All the specimens are very similar in external appearance, and their tubular processes are almost identical, but the skeleton of two of the specimens differs considerably from that of the others in the size of the spicules, which measure as follows:—

	Specimens A to G.	Specimens H & K.
Length	0·08 mm.–0·12 mm.	0·06 mm.–0·08 mm.
Diameter ...	0·008 mm.	0·008 mm.

Locality. One specimen was obtained from a buoy in Suez Bay, all the others (8) coming from Mersah Makdah.

Distribution. Red Sea.

Spinosella sororia (*Duchassaing & Michelotti*).

Synonymy:—

1864. *Tuba sororia,* Duchassaing et Michelotti (**13**).
1870. *Siphonochalina papyracea,* O. Schmidt (**25**).
1890. *Siphonochalina sororia,* Dendy (**8**).

A single incomplete specimen, consisting of one tubular process, apparently broken off from the centre of a large specimen, has been placed in this species. The lower surface of the specimen has evidently been attached to some object, but of this support there is no part on the sponge. The sponge is 55 mm. in height, and 30 mm. wide at the top, which is the widest portion, and the aperture or "pseudosculum" which occurs at the top of the tube is 10 mm. in diameter.

The surface of the sponge is raised into prominent conuli, which average 5 mm. in height. At these points the main fibres of the skeleton come to the surface.

These main fibres are arranged fairly regularly, and lie radially in the

sponge. The spicules which occur in them are very numerous, frequently lying 10- to 20-serially, and frequently being arranged in a slightly plumose fashion. Between these main fibres secondary fibres occur, forming a connecting meshwork; in these fibres the spicules are usually uniserial, but may be 2- or 3-serial. Rarely they are altogether absent from the fibre.

The spicules are small, straight oxea, abruptly pointed at each end; they measure on an average 0·08 mm. in length and 0·002 mm. in diameter.

The colour in spirit is grey-brown.

Locality. Suakin Harbour.

Distribution. Red Sea, West Indies.

SPINOSELLA INCRUSTANS, n. sp. (Text-fig. 13.)

This new species has been created for the reception of a single specimen of rather small size, consisting of four very low and wide tubes. Two of these tubes face laterally and are almost wholly fused into one, only the oscula at their summits being separate. The specimen measures in all 75 mm. long, 40 mm. broad, and the tubes vary in height from the base from 15 mm. to 25 mm. This highest point occurs on the tubes facing laterally. Each tube possesses an osculum at the summit, and these vary in diameter from 3 mm. to 6 mm.

The surface of the sponge is covered with small low conuli, whose average height is 2 mm. and which are usually 4 mm. to 5 mm. apart. In some parts, however, the conuli are much smaller and fewer, and in some parts hardly visible at all. They indicate the ends of the main skeletal fibre.

The colour of the specimen varies in different parts from light brown to dark red-brown, and purplish at the summits of the tubes.

The texture of the sponge is very firm, almost hard, and incompressible.

Skeleton arrangement.

The skeleton is a regular reticulation of spicule-covered spongin-fibre, with a fairly rectangular mesh which averages 0·4 mm. to 0·6 mm. wide in most parts of the sponge. There can be distinguished primary and secondary fibres. In the primary fibres the spicules lie 3- to 4-serial, and the fibres run radially. The secondary fibres contain only one row of spicules, and occasionally are entirely without spicules. They run both radially and tangentially in the sponge. These secondary fibres can be divided into large and small fibres. The large are nearly as thick as the primary, measuring 0·1 mm. in diameter, while the small are much thinner than the primary fibres, and only measure from 0·015 mm. to 0·02 mm. in diameter.

The dermal membrane contains a very delicate reticulation of spongin-fibre, in which spicules are rather scanty, only one or two here and there. In size they are similar to the small secondary fibres.

At the conuli which cover the surface the reticulation of the fibres becomes somewhat closer, and as a rule three or four of the primary fibres come close together, and all take part in forming the support of the conulus. Between these main fibres there occurs a dense reticulation of the small secondary fibres, and the dermal reticulation is also somewhat closer.

Fig. 13.—*Spinosella incrustans.* Spicules, ×400.

Spicules. (Text-fig. 13.)

The only spicules which occur in the sponge are oxea. They are slender, rather small spicules, which are of the same thickness for most of their length, but somewhat gradually pointed at the ends. They are almost always quite straight, but a few can be seen slightly curved. They average 0·095 mm. to 0·1 mm. in length, and are very variable in thickness. Nearly all the spicules are about 0·001 mm. in diameter, but a few may be found as much as 0·0025 mm. thick.

Locality. The specimen was attached to a dead pearl-shell obtained at Khor Dongonab.

Distribution. Red Sea.

Sub-Family Gelliinæ.

Haploscleridæ with diactinal megascleres, and sigmata or toxa or microxea for microscleres.

Gelliodes poculum, *Ridley & Dendy.* Var.

Synonymy:—

1887. *Gelliodes poculum*, Ridley & Dendy (**24**).

Two specimens of this species occur in the collection—one fairly large and apparently complete, the other a mere fragment. The larger is small compared with the 'Challenger' species, and differs slightly from the type there illustrated. It consists of an irregularly ramifying tubular basal mass, from which arise a number of upright hollow tubes. In the basal part there occur several horny Lamellibranch shells (probably *Avicula* sp.).

The largest tube is 20 mm. in diameter, and the various tubes which form the specimen vary from this size down to 3 mm. in diameter. The canal inside the basal portion is usually about 3 mm. in diameter, but may reach as much as 5 mm. The upright tubes have comparatively much larger canals inside them, and at the summit the wall of the tube is thinned out to a mere oscular rim. The oscula at the top of the tubes attain a maximum diameter

of 10 mm. They only occur on these upright processes, being entirely absent from the basal portion of the sponge.

The complete specimen measures 120 mm. in length, 60 mm. in breadth, and is 35 mm. high from the base to the top of the highest tube.

The colour in spirit is yellowish white.

The sponge is very fragile, being very easily broken at any point.

The skeleton, both in arrangement and in the spicules comprising it, is typical of the species. The sigmata, as in the type, are rather scarce, fairly large, and of the usual shape.

Locality. Along the 5-fathom line in the north-west part of Suez Bay.

Distribution. Red Sea ; Port Jackson, Australia.

Sub-Family Heteroxyinæ.

Haploscleridæ with a dense cortex composed of radially arranged megascleres. Megascleres oxea, some of which may or may not be spined. Microscleres present or absent.

This diagnosis has been slightly altered from Dendy's original one (**11**) to admit of a new genus, *Anacanthæa*, being placed in it. The position of the group is rather unsatisfactory, especially as the general character of the oxea approaches much more nearly to the Axinellidæ than to the Haploscleridæ, as it also does in the presence of trichodragmata in some species.

I have, however, left it in its original position, as I do not feel that a single specimen justifies its removal.

Anacanthæa, n. gen.

Heteroxyinæ in which the oxea are not differentiated into two forms, and without spines on them. There are no microscleres.

The present genus has been created for the reception of a single specimen, showing very great external resemblance to the genus *Acanthoxifer*, Dendy (**11**), but whose spiculation differs from this genus in the entire absence of spines from all the oxea. The placing of this new genus in this sub-family has also been decided on on account of this resemblance ; but the sub-family Heteroxyinæ, as at present constituted, does not seem to have any very definite characteristics, save that the megascleres are all oxea.

Anacanthæa nivea, n. sp. (Pl. **38.** fig. 17 ; Text-fig. 14.)

This new species, the only representative of the new genus *Anacanthæa*, is represented by a single rather small specimen. It is in the form of an

upright, rather thick lamella, growing from a small circular base. The attachment of the sponge is absent, and a portion of the sponge has been lost with it. The whole specimen is 40 mm. high, 30 mm. wide, and 8 mm. to 10 mm. thick.

The external surface, where visible, is almost exactly like that of *Acanthoxifer*, Dendy (**11**) ; the whole surface of the sponge is lined by pore-grooves, which divide up the surface into a number of polygonal or rounded areas, which measure from 3 mm. to 6 mm. in diameter. The pore-grooves are usually about 1·5 mm. wide. Each of the polygonal areas marked out by the pore-grooves is somewhat higher in the centre than at the edge, so that it has the form of a very low rounded eminence, with a perfectly smooth surface.

The pore-areas possess a special skeleton, but it is very slightly different from that of the general dermal skeleton. On the outside it is marked by the fact that the brushes of spicules project somewhat further from the surface than they do elsewhere. The pore-groove thus presents the appearance of a densely, but minutely, hispid ridge, raised very slightly above the immediate surrounding surface.

The colour of the sponge is a very slightly yellowish white, a colour probably due to the fact that it was placed in the same bottle as some deep yellow specimens, and the spirit in which the sponges were preserved is coloured a very deep yellow. Since there is no spongin in the specimen, and the surface is densely covered with spicules, the probability is that in life the sponge was a brilliant white.

The texture of the sponge is firm, almost hard, and the sponge can only be cut with difficulty.

Skeleton arrangement.

The main skeleton consists of a very dense mass of oxea, felted together without any orientation save at the surface. The whole sponge contains immense numbers of oxea throughout, almost filling the entire specimen. At the surface there are a very large number of small brushes of similar oxea, packed closely together, and forming a cortical skeleton.

Over the polygonal areas these brushes of spicules do neither attain a large size nor project much from the surface; but in the pore-grooves they are very large, sometimes containing 30 or 40 spicules, and they project considerably from the surface. In the size and shape of the spicules, however, they do not differ either from the other dermal spicular brushes or from the main skeleton.

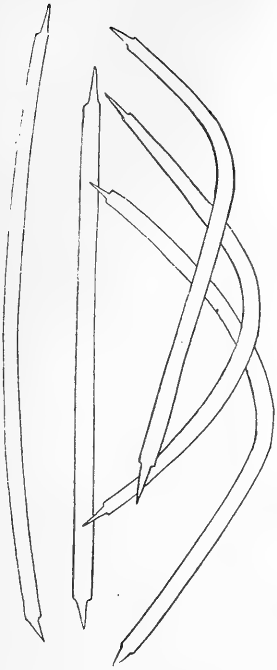


Fig. 14.—*Anacanthæa nivea.* Spicules, ×250.

Spicules. (Text-fig. 14.)

The only spicules are oxea, of varying shape and size, but not marked out into different types, as all intermediate conditions between the extremes can be found.

They are very rarely quite straight, and sometimes very strongly curved, and not always regularly; they vary considerably in length, and slightly in thickness in the full-grown specimens, but all stages of growth can be found in the sponge, and therefore all lengths and thicknesses. As a rule, those spicules which are very strongly bent are rather shorter than those which are straight. They are thickest in the middle and taper very slightly in each direction for a great part of their length; the ends are of the typical irregular Axinellid shape and are sharply pointed.

The length varies in apparently full-grown spicules from 0·35 mm. to 0·43 mm., and the thickness from 0·006 mm. to 0·01 mm.

Family Desmacidonidæ.

Sigmatotetraxonida in which some of the microscleres are chelæ (except where such have been lost by degeneration).

Sub-Family Esperellinæ.

Desmacidonidæ without echinating spicules, and without fistular outgrowths of the sponge-body.

Esperella dendyi, n. sp. (Text-fig. 15.)

This remarkable species is represented by two specimens, one of which is very small. Neither is quite complete, each showing a large torn surface. The largest consists of a roughly triangular mass, which apparently grew in an upright position; it measures 90 mm. high. The outer surface, where visible, is exactly like that of *Esperella murrayi*, of the 'Challenger' report (Ridley & Dendy (**24**)), being marked out into irregularly shaped areas by the peculiar meandering pore-grooves which are characteristic of these two

species. These pore-grooves are very well marked in the present species, quite as well as in *Esperella murrayi*, and their skeleton is identical in structure with that of the 'Challenger' species.

The colour of the specimens in spirit is white with a yellowish tinge.

The interior of the sponge is cavernous and rather lax, and the dermal skeleton is not so dense as in *Esperella murrayi*, otherwise the two species are almost exactly similar in skeleton arrangement.

Skeleton.

The main skeleton consists in huge bundles of monactinal megascleres which spread out on the surface to meet the adjacent bundles. The distance between the bundles immediately below the surface is about 1 mm. to 2 mm. on the average ; the bundles of spicules average 0·12 mm. to 0·13 mm. in diameter. In the interior of the sponge the spicular arrangement becomes much more confused, and the bundles are difficult to distinguish. Between these spicule-bundles occur large subdermal cavities irregularly arranged, into which open the channels from the pore-areas ; from these subdermal cavities there leads down into the interior of the sponge a system of large and very numerous canals.

The whole tissues of the sponge are filled with enormous quantities of raphides and trichodragmata, with conspicuous rosettes of remarkable anisochelæ near the surface. Small anisochelæ of quite another type also occur in the sponge, scattered throughout the tissues, and especially abundant on the dermal membrane.

Spicules.

A. Megascleres.

The only megascleres are styli which form the spicular bundles referred to above. They average 0·5 mm. long and 0·01 mm. in diameter.

B. Microscleres.

(*a*) Chelæ. (Text-fig. 15.)

Scattered fairly plentifully about immediately below the surface are very large rosettes of palmate anisochelæ of very striking form. These chelæ form the great distinction between this species and *Esperella murrayi*. The rosettes are about 0·12 mm. in diameter and contain numerous chelæ. The chelæ are characterised by the extremely stout and strongly curved shaft and by the comparatively large size of the smaller end. The chelæ measure 0·055 mm. to 0·06 mm. in length and 0·032 mm. wide at the widest point. Both median and lateral palms are present at each end, and the palms are of large size. The lateral palms of the larger end extend some way down the shaft in most cases. The shaft is oval in section and measures 0·01 mm. by 0·006 mm. in major and minor diameters.

The smaller anisochelæ are not arranged in rosettes and are much more typical in shape. They measure 0·026 mm. in length. The palms of the larger end are well developed, especially the median one, but they are very small indeed at the small end.

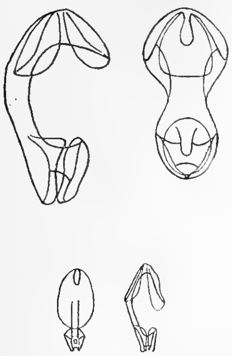


Fig. 15.—*Esperella dendyi.* Anisochelæ, ×450.

(*b*) Trichodragmata.

The trichodragmata occur in enormous numbers throughout the sponge; they measure 0·065 mm. to 0·08 mm. in length. They are composed of numerous very slender raphides.

(*c*) Raphides.

Extremely slender raphides also occur in large quantities through the sponge. They are exactly like the individual raphides of the trichodragmata.

Locality. No definite locality is given, but the bottle bears a label "Sponge Trials 1."

Distribution. Red Sea.

ESPERELLA EUPLECTELLIOIDES, n. sp. (Pl. **37.** fig. 12; Text-fig. 16.)

A single specimen of this remarkable sponge occurs in the collection. As the name indicates, the external form of the sponge is very similar to that of the Hexactinellid genus *Euplectella.*

The sponge is attached to its support by a small base measuring about 35 mm. × 22 mm. in extent, but the actual area of attachment consists of an irregular surface, which appears to have been situated vertically and which does not entirely cover the base of the sponge. From this base the sponge grows erect, the lower part being curved abruptly to bring the sponge into this position.

The body of the sponge consists of a hollow cylindrical tube, 200 mm. in height and about 100 mm. in diameter at the widest part, which occurs about halfway up. The cylinder is widely open at the top, the aperture being slightly oval and 75 mm. across.

The wall of the cylinder consists of a coarse and very irregular reticulation of skeletal fibre, covered with sarcode. This fibre consists of a core of spicules coated with spongin. The diameter of the fibres varies very much, some of them being very delicate, while the largest fibres, which occur towards the base of the sponge, reach 1·0 mm. in diameter, or possibly even more. The fibre reticulation is very irregular, and large and small fibres are mixed up together in such a way that it is quite impossible to call some primary and others secondary fibres. In fact, there does not seem to be any distinction between the fibres, save that of size. In the same way the meshwork made by

these fibres is very irregular, and the diameter of the holes varies from practically nothing to 5 mm. in diameter. Where this mesh is wide the sarcode coating the fibres frequently does not fill the spaces, so that large holes and cavities occur throughout the sponge-wall; but where the reticulation of the fibre is compact, the sarcode completely fills up the interspaces. Thus the sponge-wall consists of a number of tracts, of greatly varying size and irregular arrangement, where the sarcode around the various skeletal fibres has completely fused together, united to each other by similar tracts or by fibre-covered bars of sarcode, and between these tracts there occur large interspaces, transforming the wall of the sponge into a very irregular honeycomb. By the various spaces in the wall, the cavity of the interior of the sponge-cylinder is placed in communication with the exterior.

The inner surface of the sponge-cylinder is comparatively smooth, though the sarcode tracts are covered with low ridges and small prominences, owing to the irregularity of the skeletal fibre. This fibre does not proliferate towards the interior of the sponge-cylinder, however, so that these irregularities of surface are confined to one plane, that of the surface itself.

On the other hand, the outer surface of the sponge-wall is covered with a forest of protruding fibres, which branch out and anastomose with one another profusely. These fibres in their distal portions are almost bare of sarcode, and appear as small tree-like processes outside the general tissues of the sponge.

The oscula are not easy to distinguish from the interspaces between sarcode tracts, but true oscula appear to be fairly common, irregularly scattered over the whole surface of the sponge. They are quite small, rarely exceeding 1·0 mm. in diameter. They occur on the inside as well as the outside of the cylinder wall. Where pores could be distinguished, they were extremely numerous, scattered thickly and regularly over the dermal membrane of the sponge. They are quite small and appeared somewhat irregular in outline. They are not located in special pore-areas, and no special skeleton is present in connection with them.

As stated above, the spicule-covered fibre which forms the main skeleton may reach a diameter of over 1·0 mm., and all sizes less than this maximum can be distinguished. The fibres are entirely filled up with spicules of various kinds, of which the most frequent by far are tylostyles, with considerable numbers of foreign bodies, chelæ, and sigmata, and broken spicules mixed with them. The tylostyles and the broken megascleres, whether foreign or not, lie longitudinally and very regularly in the fibre, but the chelæ and sigmata, and the non-spicular foreign bodies, which are usually quite small, lie entirely without orientation in the fibre. The spongin which coats the spicule is dull yellowish brown in colour, and even in the largest fibres does not greatly exceed the spicular bundle in diameter. In fact, spicules seem to

be added during the whole life of the fibre, though no spicules seemed to occur just outside the spongin, as one would expect if this were the case.

The branching of the skeletal fibre is very irregular and many anastomoses occur between the fibres in the deeper parts of the sponge-wall. On the outside of the sponge the fibres which extend furthest are often entirely free from any covering of sarcode, and the spicules do not project from the spongin.

Outside these fibres megascleres are somewhat rare, but a few spicule-fibres entirely free from spongin occur. The spicules composing these fibres are always wholly tylostyles, exactly similar to those of the main fibres, and, as far as could be ascertained, in no way distinguishable from them, and they very rarely lie more than 5- or 6-serial in the fibres. Owing to the peculiar structure of the sponge-wall, no definite direction can be assigned to these fibres, but they nearly always have one end projecting from the sponge-wall.

Isolated tylostyles may also be occasionally found in the sponge, but these are very rare, and are not related to any definite part of the sponge.

The microscleres are extremely numerous, and consist of small anisochelæ and comparatively large sigmata. They are arranged quite irregularly in the sponge, and no anisochele rosettes occur.

Spicules.

A. Megascleres.

The tylostyles referred to above are the only megascleres occurring in this species. They are somewhat small, straight, conical, and the shaft tapers gradually from the head to the apex. The head is typically Esperelline in shape, being oval, with the long axis of the head a continuation of the axis of the whole spicule. The length of the spicule varies from 0·157 mm. to 0·21 mm., but by far the greater number of spicules approximate very closely to the latter measurement.

The diameter of the shaft at its thickest point (close to the head) is 0·003 mm. in full-grown specimens, and very slightly under this in immature spicules. The head averages 0·007 mm. in length by 0·0045 mm. in greatest diameter. There is no difference in measurements between the tylostyles of the skeletal fibres and those scattered about in the sarcode.

B. Microscleres. (Text-fig. 16.)

(i.) Chelæ. (Text-fig. 16, A.)

The chelæ occur scattered throughout the whole of the sponge, and entirely without orientation or definite arrangement, either in reference to the sponge itself or to one another. They are extremely numerous in all parts of the sponge.

The chelæ are palmate anisochelæ of rather small size, with the "palms" extremely delicate and difficult to distinguish. They measure 0·026 mm. long.

In addition to these large forms there occur also larger numbers of smaller anisochelæ, which are also scattered about without orientation or arrangement. They are apparently the young forms of the above anisochelæ, as all intermediate stages can be found.

(ii.) Sigmata. (Text-fig. 16, B.)

The sigmata are comparatively large and of typical **C** or **S**-shape. They are not nearly so numerous as the anisochelæ, but, like them, they are not

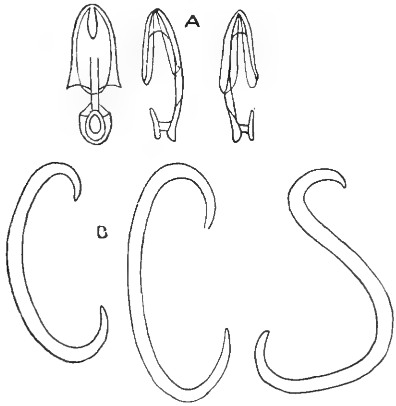


Fig. 16.—*Esperella euplectellioides.* Microscleres, × 675.

orientated at all in the sponge. They measure on the average 0·05 mm. to 0·06 mm. across the curve, and about 0·1 mm. along the spicule itself. They are comparatively slender, being not more than 0·0012 mm. in diameter. No small or immature sigmata were seen.

Locality. No locality is given.
Distribution. Red Sea.

Esperella fistulifera, n. sp. (Text-fig. 17.)

The characteristic feature of the present species is the external form. It consists of an undivided basal portion, of considerable size and very irregular shape, from the surface of which arise large numbers of small tubular processes, each with an osculum at the summit. These processes frequently occur in groups arising from a common stalk, so that the whole group may possibly arise by the branching of a single process. They occur over the whole of the upper surface of the sponge, and also in considerable numbers on its sides. They invariably stand erect, those arising on the sides of the mass being sharply curved at their base so as to assume the vertical position immediately.

These processes vary very considerably in length, but never appear to exceed 10 mm. when single, but a group of processes as a whole may reach a

length of 25 mm. or even 30 mm. The largest complete specimen in the collection measures 120 mm. in length, 45 mm. in breadth, and 55 mm. high to the summit of the processes.

The surface of the sponge is smooth and even, and no reticulation can be seen on it. Under the microscope it is very minutely hispid, owing to the projection of spicules from it.

The oscula are confined to the summits of the processes above described and are very small. When widely open (at any rate in my specimens) they do not exceed 0·8 mm. in diameter, and in most cases they do not measure more than 0·3 mm. to 0·5 mm. A few of them are completely closed and invisible, the process being lipostomous. The pores are exceedingly minute and are scattered all over the sponge-surface.

The colour is a dull yellowish grey, due doubtless to a large extent to the great quantities of mud the sponge has engulfed.

The texture is very lax and soft, and the whole sponge is very fragile and easily broken.

Skeleton arrangement.

The skeleton consists almost entirely of rather sparsely and quite irregularly scattered tylostyles, but here and there occur slender spicular fibres, composed of spicules exactly similar to those scattered throughout the sponge. These fibres run irregularly in the sponge-body, even in the processes, but, as a rule, they tend toward the surface and finally project from it. In the processes they also run more or less longitudinally. The number of rows of spicules composing them varies from 3 in small fibres to 6 to 8 in the largest.

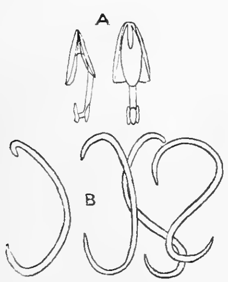


Fig. 17.
Esperella fistulifera.
Microscleres:
A ×650; B ×380.

Spicules.

A. Megascleres.

The only megascleres which occur in this sponge are sub-tylostyli. They are very slender and always quite straight. The head is small and oval, and has its longest axis a continuation of the axis of the shaft of the spicule. The average length of the spicule is 0·25 mm. The thickest part of the shaft is close to the head; from these the spicule tapers very gradually to a very fine point. The diameter of the spicule is about 0·002 mm. at the thickest point, and that of the head 0·0025.

B. Microscleres. (Text-fig. 17.)

(i.) Chelæ. (Text-fig. 17, A.)

The chelæ are very small palmate anisochelæ, which occur sparsely scattered about throughout the sponge. They do not form rosettes, nor are they more

plentiful in any one part of the sponge than in another. They measure 0·023 mm. in length, and 0·008 mm. in breadth in the largest examples.

There are also present much smaller chelæ, which are apparently the young forms of the above. All intermediate sizes can be seen.

(ii.) Sigmata. (Text-fig. 17, B.)

Like the chelæ, the sigmata are not numerous in any part of the sponge, but they are somewhat more frequent than the former. They are not very regular in shape, showing very considerable variation in the amount of the curvature, and also in the abruptness of the curve. They measure 0·035 mm. to 0·04 mm. across the curve and from 0·001 mm. to 0·003 mm. in diameter.

Locality. Suez.
Distribution. Red Sea.

Esperella suezza, n. sp. (Text-fig. 18.)

This new species is represented by several specimens, all more or less damaged, owing to their very lax nature. Each specimen consists of a mass of tissue showing only a small portion of the true external surface. Several are attached to horny Lamellibranch shells (probably *Avicula*). In those specimens where the external surface can be seen, it appears to be fairly regular and to be covered with small, very low, rounded prominences, which are on the average 5 mm. in diameter.

The surface is apparently quite smooth and almost glabrous.

The oscula and pores could not be made out in most of the specimens, but in one case a few small oscula were seen, measuring about 1 mm. in diameter.

The colour in spirit is a dirty dark grey.

The texture of the sponge is very lax, and the sponge is very easily broken into fragments. Nearly always, however, the sponge tears apart vertically.

No further details of external appearance can be given owing to the fragmentary nature of the specimens.

Skeleton arrangement.

The main skeleton consists of spicular fibres, which lie very irregularly in the sponge. They do not form a reticulation of fibres, but lie in sinuous and irregular lines throughout the sponge. They also do not seem to be very long, but frequently stop short abruptly. The fibres branch frequently, sometimes forming a tree-like group of fibres, but the fibres never anastomose with each other and some of them are very short. A few fibres project from the surface.

The number of spicules which go to form any fibre varies enormously, especially according to whether the fibre is near the surface or far from it. In the former case the fibres may contain only 2 or 3 rows of spicules, and

rarely possess more than 5 or 6, while in the deeper parts of the sponge there may be 20 or 25 rows of spicules in each fibre.

In addition to the spicular fibres, there also occur considerable numbers of scattered spicules throughout the sponge. They are exactly similar to those found in the fibres.

There is no special cortical skeleton.

Spicules.

A. Megascleres.

The only megascleres present are tylostyli, which possess well-marked heads. The spicule is fairly stout, cylindrical, and the shaft is thickest close to the head, from which point it gradually tapers down to a very fine point. The spicules are always quite straight. They measure from 0·32 mm. to

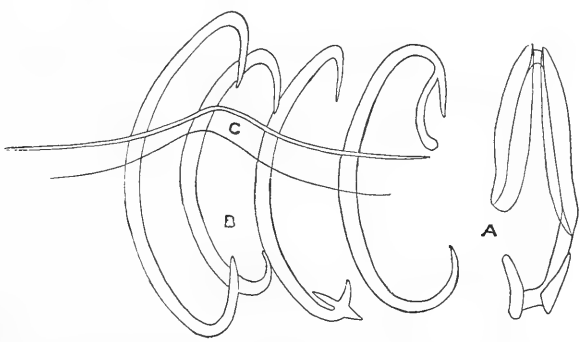


Fig. 18.—*Esperella suezza.* Microscleres: A ×1000; B & C ×675.

0·33 mm. in length and 0·004 mm. in diameter at the thickest point in the shaft. The head, which is oval, measures 0·005 mm. in diameter.

B. Microscleres. (Text-fig. 18.)

(i.) Chelæ. (Text-fig. 18, A.)

The palmate anisochelæ are very abundant, occurring in large numbers throughout the sponge. They do not form rosettes. They are not very large, and the length of the largest specimens does not exceed 0·04 mm. Small forms are very numerous indeed.

(ii.) Sigmata. (Text-fig. 18, B.)

The sigmata are large, and are present in the sponge in enormous numbers, so that in some places they almost form a solid mass. For the most part they are **C**-shaped, but occasionally specimens may be seen contort. The average length of the sigmata, measuring across the curve, and not along it, is 0·07 mm., and the diameter of the spicule 0·004 mm.

Sigmata are occasionally found in which one of the ends is malformed, either swollen, or knobby, or possessing one or more excrescences or rays upon it. Typical examples are shown in the text-figure.

(iii.) Toxa. (Text-fig. 18, C.)

The toxa are very large, but not numerous. The amount of curvature varies considerably, and also the abruptness of the curve. For almost its whole length the toxon is very slender, so slender that the diameter cannot be accurately measured, but at the centre of the bow it swells out into comparative stoutness. The ends of the spicule taper off to so delicate a point that it is almost impossible, when examining the spicules *in situ*, to ascertain the exact point at which they end; and in boiled-out preparations they are invariably broken. For this reason the lengths given here are only to be considered approximate. The length varies very considerably, from 0·31 mm. to 0·21 mm. The diameter at the centre is 0·001 mm., while the greater part of the spicule does not exceed 0·00025 mm. in diameter.

Locality. Suez.
Distribution. Red Sea.

ESPERELLA ERYTHRÆANA, n. sp. (Text-fig. 19.)

The present species is represented by four specimens all growing over masses of calcareous Polyzoan tubes. In Mr. Crossland's notes they are described as follows:—"Patches of a very delicate branched Polyzoan, and with this Sponges, Compound Ascidians, &c."

Neither of the specimens is large, the largest measuring 65 mm. long, 52 mm. wide, and 25 mm. high. They are unattached to any foreign body, but apparently are loosely embedded in mud. The whole mass is quite amorphous, and no definite external form can be assigned to it.

The surface is smooth, but irregular, for branches of the Polyzoan project here and there all over the sponge, and in other places branches just beneath the dermal membrane cause projections and ridges to appear on the sponge-surface. Where the polyzoan is absent the surface is perfectly smooth and even.

The oscula are very small, not exceeding 0·5 mm. in diameter. They are very inconspicuous, and can only be distinguished on the surface by means of a lens. They are very numerous and are scattered fairly evenly over the whole sponge surface.

The pores are large, measuring from 0·15 mm. to 0·2 mm. in diameter. They occur in large numbers everywhere on the outside of the sponge, usually scattered singly, but occasionally in small groups. These groups, however, never form true pore-areas.

The colour is dark grey-brown in spirit.

The texture of the sponge is lax, and where it is not held together by the polyzoan it is very easily torn. The whole mass, however, is firm and fairly resistant, since the polyzoan tubes serve as a supporting framework.

Skeleton arrangement.

The main skeleton consists of a large number of spicular fibres, which run irregularly in the sponge. In the central parts of the sponge the fibres are very stout and frequently contain 30 or even more rows of spicules. As they get nearer the surface they frequently branch, and each time the branches into which they divide are smaller than the parent fibre, so that at the surface the average number of rows of spicules in a fibre does not exceed three to five. The general tendency of the fibres is to run more or less toward the surface, but the individual fibres show very great irregularities of position. The various fibres never anastomose with one another, and rarely cross, and their frequent branching when near the surface results in a tree-like appearance, when seen in a section. The spicules are sometimes arranged in a slightly plumose fashion in the fibres, especially in the large ones.

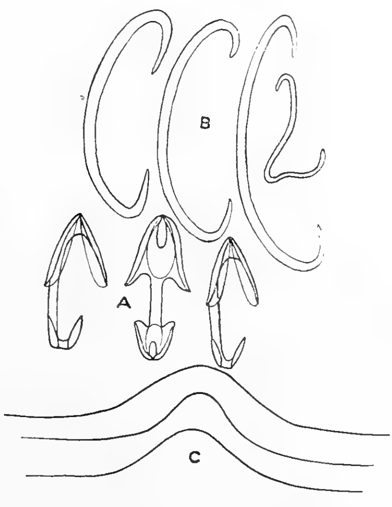


Fig. 19.—*Esperella erythræana.* Microscleres, × 500.

At the surface of the sponge the fibres expand into loose brushes, about 0·15 mm. wide on the average, and containing possibly 20 to 25 spicules.

The dermal membrane is protected by a delicate, though irregular reticulation of spicular fibre. These fibres run without any orientation (save that they are necessarily longitudinal) over the surface of the sponge, and usually contain two or three rows of spicules, very rarely four or five. They do not branch or anastomose with one another.

The dermal membrane also contains a few anisochele rosettes.

Spicules.

A. Megascleres.

The only megascleres occurring in this sponge are subtylostyli, and there is no difference either in shape or measurement between the spicules of the dermal reticulation of spicule fibre and those of the main skeleton.

They consist of a long slender shaft, with a very slightly developed head at one end, and have a very fine point at the other. The thickest part of the shaft is about halfway along the spicule, and from this point the shaft gradually tapers towards either end. The head is very small and oval in shape, with its longer axis a continuation of the axis of the spicule-shaft.

The length of the spicule varies from 0·32 mm. to 0·33 mm., and the average diameter of the shaft at its thickest point is 0·004 mm. The diameter of the head varies from 0·004 mm. to 0·0045 mm.

B. Microscleres. (Text-fig. 19.)

(i.) Chelæ. (Text-fig. 19, A.)

The chelæ are confined almost entirely to the dermal membrane, where they occur in conspicuous rosettes, measuring 0·07 mm. in diameter. The chelæ are palmate anisochelæ, and their length is usually from 0·024 mm. to 0·036 mm. The width of the chela is on the average 0·0115 mm.

A large number of small chelæ were seen, some being isochelæ, and varying very much in size, in all parts of the sponge. They do not form rosettes, and were usually scattered about singly. Their average length is 0·015 mm.

(ii.) Sigmata. (Text-fig. 19, B.)

The sigmata are not very plentiful, but occur in all parts of the sponge. They are usually **C**-shaped, but also can be found contort. They vary considerably in size and to some extent in shape. They measure from 0·05 mm. to 0·075 mm. across the curve of the sigma, and their diameter does not exceed 0·002 mm.

(iii.) Toxa. (Text-fig. 19, C.)

The toxa are very few in number, and only occur in the deeper parts of the sponge. They are strongly bowed, and very slender throughout their length, so much so that at the extremities it is very difficult to determine the ends of the spicule with accuracy. Their average length is 0·09 mm., and their diameter less than 0·0005 mm.

(iv.) Raphides.

Numerous very slender hair-like oxea occur throughout the sponge. It is not possible to say for certain whether they are young oxeote forms of the regular styli or true raphides. They vary in length from 0·02 mm. to 0·15 mm. Their diameter rarely exceeds 0·001 mm.

Locality. Khor Shinab.
Distribution. Red Sea.

Sub-Family Ectyoninæ.

Desmacidonidæ in which some of the megascleres take the form of spined styli, originally developed as echinating spicules of the skeleton fibre or projecting at right angles from the substratum.

Myxilla isodictyalis (*Carter*).

Synonymy:—

1882. *Halichondria isodictyalis,* Carter (**4**).

There is a small fragment of this species in the collection, which, though extremely small and fragmentary, is easily recognizable as this species by its skeleton arrangement and spicules, which agree with Carter's original description in every particular.

Locality. Suez mud-flats.

Distribution. Red Sea, Acapulco.

Myxilla cratera, n. sp. (Pl. **37**. fig. 13 ; Text-fig. 20.)

This new and remarkable species is represented in the collection by a considerable number of specimens, all of which are very similar in external appearance. They each consist of a cushion-like mass of rather irregular shape and varying size, attached to some foreign body by a large base. The largest specimen measures 50 mm. by 32 mm., and is 25 mm. high from base to summit.

The surface is covered thickly with small crater-like projections, which are pore-areas, and which measure about 2 mm. to 3 mm. in diameter on the average.

Each pore-area is raised on a more or less circular wall from the regular surface of the sponge, and this wall is usually about 0·7 mm. high. Inside the cone thus formed, but rather below the top of the wall, a membrane is stretched, in which are pierced a very large number of pores of small size. (There are sometimes hundreds of minute pores in a single pore-area.) Below the membrane is a large cavity, above the surface of the sponge, and occupying almost the whole of the inside of the crater-like process. At the level of the general surface of the sponge there is another membrane, this time apparently sphinctrate, which can close (presumably) the entrance to the inhalant canals, which run directly down from these "pore-cones" into the interior of the sponge.

These pore-areas, as can be seen in the photograph (Pl. **37**. fig. 13), are packed together thickly over the whole surface of the sponge. They extend right down the sides of the cushion to the base.

The oscula are small, and are provided with special cones like the pore-

areas. In this case, however, the sieve-membrane stretched over the pore-area is replaced by a sphincter-membrane. The oscula usually measure about 1·5 mm. to 2·0 mm. in diameter.

The colour is yellowish white in spirit.

The texture is firm, resistant, and hardly at all compressible.

Skeleton arrangement.

The main skeleton consists of a very dense and quite irregular mass of spined styli, lying in the sponge entirely without orientation. Here and there a few spicular fibres can be seen, but these fibres are very few and are not oriented, so that it seems probable they are but accidental, owing to the spicules lying parallel instead of irregularly at that particular spot.

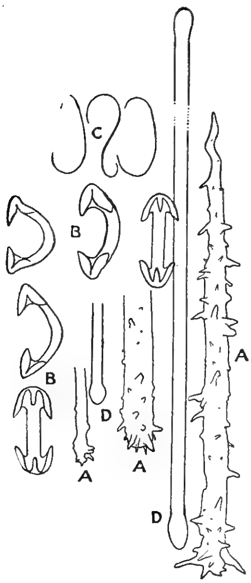


Fig. 20.—*Myxilla cratera.* Spicules, × 650.

At the surface of the sponge tylote spicules are met with. In the actual dermal surface, between the "pore-cones," both tylota and acanthostyli occur, promiscuously mixed with each other, and tylota are also found below the surface, but always near it.

The pore-cones are supported by a special skeleton, composed entirely of tylostyles, and the oscular cones have an exactly similar skeleton. The wall of the cone is supported by numerous dense bundles of tylota, arranged vertically in the cone-wall. These bundles are about 0·15 mm. in diameter, and the spicules in them are very densely packed. They are separated from each other by a width approximately equal to the diameter of the bundle. In the sieve-membrane there frequently occur single tylota and large numbers of chelæ, but there is no special skeleton.

Spicules. (Text-fig. 20.)

A. Megascleres.

(i.) Tylota. (Text-fig. 20, D.)

Rather long, slender tylota, with a slight but curiously shaped head. In no part is the head of much greater diameter than the shaft of the spicule, but it is quite definitely, if slightly, larger than it; but instead of being rounded off on the distal side, the head is occasionally almost sharply pointed. The tylota are confined to the dermal membrane and adjacent parts. Length 0·23 mm. on the average; diameter 0·003 mm. Diameter of head 0·004 mm.

(ii.) Styles. (Text-fig. 20, A.)

All the styles have spines on them, both at the surface and in the interior of the sponge, but both in amount of spinulation and in the length of the spines considerable variation occurs, the spicules nearest the surface being the most spiny, both in number and length of spine. Great variation also occurs in the length of the spicule, those in the interior of the sponge being much larger than those near the surface. Thus the largest spicules have the fewest spines and *vice versâ*. The length of the styles varies from 0·1 mm. to 0·24 mm. The diameter of the head, excluding spines, is on the average 0·01 mm.

B. Microscleres.

(i.) Chelæ. (Text-fig. 20, B.)

The chelæ are tridentate isochelæ, and they occur chiefly on the sieve-membranes of the pore-areas and near the dermal surface of the sponge. They also occur in large numbers among the tylota forming the skeleton of the pore-areas, and in the sphincter-membranes over the inhalant canals. They are all similar, and measure 0·02 mm. in length. The diameter of the shaft is 0·0036 mm.

(ii.) Sigmata. (Text-fig. 20, C.)

A few sigmata occur scattered about in the sponge. They are very slender, C-shaped or contort, and usually measure about 0·02 mm. in length.

Locality. No locality is given, the bottles containing the specimens being merely labelled " Sponge Trials 1."

Distribution. Red Sea.

MYXILLA TENUISSIMA, n. sp. (Text-fig. 21.)

There are three specimens of this species in the collection. Each of them consists of very thin lamellæ covering over a mass of calcareous and siliceous débris, but whether the sponge gathers these fragments together during its growth, it is impossible to say. In most parts the lamella covering the débris is extremely thin, often not exceeding 0·05 mm. in thickness, but occasionally, in crevices or between two pieces of débris not close together, the sponge may have a thickness of 0·3 mm. or even 0·5 mm. The largest specimen forms an irregular mass 30 mm. × 25 mm. and is 25 mm. high.

The surface is quite smooth and even, but under the microscope it can be seen to be very minutely hispid, owing to the projection from the surface of the points of the acanthostyli.

The oscula and pores could not be made out.

The colour of the specimens in spirit is a dense black, the pigment being contained in immense numbers of spherical or stellate cells, which occur throughout the sponge. Frequently these pigment-cells are arranged in bands along the surface of the sponge, but the meaning of this could not be ascertained.

Skeleton arrangement.

The main skeleton, which is also the dermal skeleton, owing to the peculiar character of the sponge, consists of an irregular reticulation of spicular fibres, which run tangentially just under the surface of the sponge. The spicules composing them are tylota, and there are usually several (six or eight) rows of spicules in the fibres. These fibres run quite irregularly, but do not seem to branch or anastomose.

In addition to these spicular fibres, there occur very large numbers of spined styli, which are arranged vertically to the surface. They occur scattered singly over the sponge surface and are fairly evenly and regularly distributed over the whole sponge. As a rule, they project for about half their length from the sponge surface.

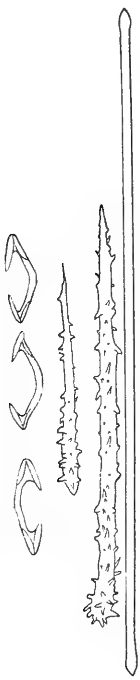


Fig. 21.—*Myxilla tenuissima.* Spicules, ×650.

Spicules. (Text-fig. 21.)

A. Megascleres.

(i.) Tylota.

The tylota are straight, slender spicules, with very slight heads. As was noticed in *Myxilla cratera*, the distal ends of the head are pointed instead of being rounded, and in the present species it is even more noticeable than in the former. They are, as a rule, about 0·16 mm. long, and the shaft, which is of almost the same thickness for the whole of its length, measures 0·002 mm. in diameter. The head does not exceed 0·003 mm. in diameter in most of the specimens, but a few were seen with large swollen heads, very similar to those of *Suberites*. These spicules are probably foreign.

(ii.) Styles.

The styli are all thickly covered with fairly long spines, and throughout their whole length; also the spines are largest towards the head. They vary very considerably in length, probably owing to the variation in thickness of the sponge-film, and all measurements of length may be found between 0·05 mm. and 0·115 mm. The diameter of the head of the spicule, excluding the spines, measures 0·004 mm.

B. Microscleres.

The only microscleres present in this species are tridentate isochelæ, which occur sparsely scattered throughout the sponge. The shaft of the chela is curved, almost bow-shaped, and the head is well developed. The chela measures 0·02 mm. to 0·024 mm. in length.

Locality. All three specimens were obtained in Suakin Harbour, in 5 fathoms of water.

Distribution. Red Sea.

OPHLITASPONGIA (?) ARBUSCULA, n. sp. (Pl. **39.** fig. 22; Pl. **40.** fig. 25; Text-fig. 22.)

This species has been created for the reception of two large tree-like specimens which were obtained together from a locality not stated. Each specimen consists of a considerable number of long irregular branches, which themselves branch irregularly, arising (and presumably growing more or less erect) from a small base. In the larger specimen the exact size and character of the pediment cannot be ascertained, as a portion of it is broken away, but the portion remaining measures 28 mm. by 15 mm. From this base four branches arise immediately, and there is no undivided basal portion of the sponge save the flat thin and encrusting pediment itself. The smaller specimen is even more incomplete than the larger, and in this case the pediment is entirely wanting.

The branches which form the sponge are irregular in shape, but usually more or less cylindrical. Numerous prominences and swellings occur on them, however, and here and there short processes arise from them which are apparently the commencements of new branches. The actual size of the branches also varies. The largest reach an extreme length, in the larger of the two specimens, of about 500 mm., but their fairly frequent branching, and the junctions which occasionally occur between contiguous branches, and also the manner in which the branches lie tangled up together, tend to diminish very considerably the height of the actual specimen. The branches vary in diameter from 5 mm. to 10 mm.

The outer surface of the sponge is harsh and often gritty, owing to the frequent occurrence of an incrustation of foreign bodies upon it. These are mostly sand-grains and minute coral fragments, but an encrusting polyzoan also grows over the sponge. The actual surface of the sponge is quite smooth, being covered by a very delicate dermal membrane, but it is covered with slight prominences and low ridges, owing to the pushing up of the dermal membrane by skeletal fibres lying just below. However, there are no actual projections of either fibre from the surface, but the spicules project very slightly and render it minutely hispid.

Both the specimens are apparently lipostomous, no oscula being distinguishable on either. The pores are very numerous and small, and are scattered all over the sponge surface, there being no special pore-areas.

The colour of the sponge is described by Mr. Crossland as "brick-red" during life, in spirit it is dark brown-black on the outside and orange-brown within; the spirit in which the sponge has been preserved is coloured bright orange-red.

Skeleton arrangement. (Pl. **40.** fig. 25.)

The main skeleton consists of a dense reticulation of spicule-cored fibre, and of spicules scattered irregularly about throughout the sponge. The fibres are strongly coated with spongin and the reticulation is very close. There cannot be made a distinction into primary or secondary fibre, no separation of the fibres into groups being possible either in direction or size, for the reticulation, although the fibres are unoriented, is fairly regular, and they are all of equal size. The fibres average 0·08 mm. in diameter, but where a junction between two or more fibres occurs there is a slight swelling into a knob, which usually measures 0·12 mm. in diameter. The spongin coating the fibres is made up of a series of layers, and the divisions between the various layers can very easily be seen.

The dermal skeleton consists of dense brushes of spicules, typically arranged fanwise at right angles to the surface of the sponge, but also frequently almost tangential in direction. As a result, the dermal skeleton forms a dense felting over the surface of the sponge.

Spicules. (Text-fig. 22.)

A. Megascleres. (Text-fig. 22, A.)

The whole of the megascleres are subtylostyles, and the spicules of the fibres are not distinguishable either in size or shape from those of the dermal skeleton or those scattered throughout the sponge. In almost all the fibres they form a slender core, being usually arranged 2- to 3-serially; but in some fibres they are uniserial, or in rare cases even entirely absent. They are frequently arranged in a slightly plumose manner within the spongin-fibre, but they never project outside it. Thus, although true echinating spicules are entirely absent in this species, they seem to retain some slight indication of Ectyonine affinity.

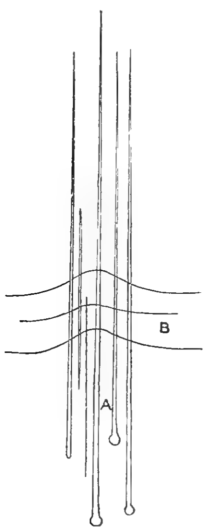


Fig. 22.
Ophlitaspongia arbuscula.
Spicules, × 250.

The spicules are slender, frequently curved, and, not always uniformly throughout their course, they seem to follow the curve of the fibre. They almost always possess slight heads, which are oval, with the long axis of the head a continuation of the axis of the spicule. The size varies considerably, and spicules in the fibres seem to attain slightly larger dimensions than those outside them, but this difference is very slight and may not be so in all parts of the sponge. The length of the average spicule is 0·3 mm., but specimens measuring as much as 0·33 have been seen. Their diameter

does not exceed 0·002 mm. at the thickest part of the shaft, which is of equal diameter for almost the whole of its length; the head measures on the average 0·0025 mm. in diameter. A few spicules occur with oxeote or stylote ends.

B. Microscleres. (Text-fig. 22, B.)

The microscleres present in this species are toxa and are of extreme rarity, a single toxon being only found at long intervals during a careful search. That they acutally belong to the sponge is, however, shown by the facts that they are all exactly similar and that no other foreign bodies occur in the sponge.

They are straight for most of their length, being sharply bowed in the centre, and they taper very gradually from the centre to each end. The actual ends are so delicate that it is a matter of considerable difficulty to ascertain the exact end to the spicule. They measure in length 0·06 mm., and are 0·0015 mm. wide in the centre.

Locality. No definite locality is given for these specimens.

Distribution. Red Sea.

OPHLITASPONGIA (?) HORRIDA, n. sp. (Pl. **40**. fig. 26; Text-fig. 23.)

The present species is very similar in its general character to the previous one, but differs from it in external form, in the character of the skeletal reticulation of spongin-fibre, and also in the shape of the toxa.

The single specimen which represents this new species consists of a low, irregularly branching mass, creeping on coral and calcareous shells, from which arise at frequent intervals stout and short processes which frequently branch. The length of these processes between points of branching rarely exceeds 15 mm. The processes themselves and the branches into which they divide are stout and rather irregular in shape; they are usually about 10 mm. in diameter, but are flattened and somewhat strap-shaped, in which case their greater diameter may be 15 mm. or 18 mm. and the shorter 5 mm.

The surface of the sponge is smooth, but not glabrous, as it is echinated by the projecting ends of the spicules of the dermal skeleton.

The oscula are numerous and very minute, not exceeding 0·2 mm. in diameter; they are scattered irregularly over the whole surface of the sponge.

The pores are scattered, very numerous, and small.

The colour of the sponge is yellowish grey in spirit.

The texture is firm, almost hard; it is somewhat compressible and very resilient. The sponge can be cut fairly easily, but torn with great difficulty.

Skeleton arrangement. (Pl. 40. fig. 26.)

In general, the skeleton arrangement is very similar to that of *Ophlitaspongia arbuscula*, above described. There is the same dark-orange spongin-fibre feebly cored with monactinal megascleres, and the same large numbers of spicules scattered about throughout the sponge. There is also present a dermal skeleton, even more dense than in the former species. It consists of brushes of spicules, whose ends project from the surface, and which are densely matted together. There are, in addition, large numbers of spicules lying in a tangential position, and others which occupy positions intermediate between the radial and tangential, so that the whole makes a very dense felt-like covering to the exterior of the sponge. Frequently, also, large sand-grains occur either enmeshed in the dermal skeleton or else lying immediately below it.

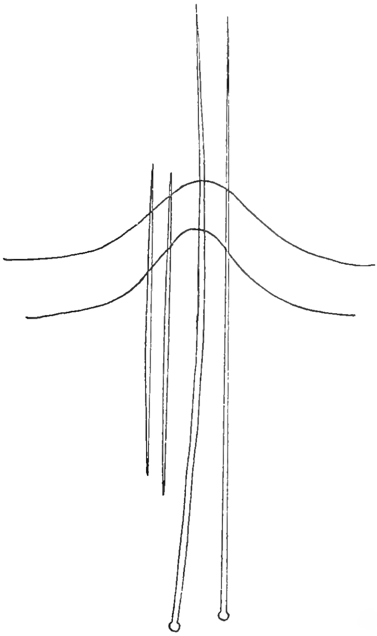


Fig. 23.—*Ophlitaspongia horrida.* Spicules, × 315.

The reticulation of the spicule-cored spongin-fibre of the main skeleton is much less regular than in *O. arbuscula*, and the mesh is elongated and varies so much in size that it is almost impossible to give an average. As limits 0·2 mm. and 1·5 mm. may be suggested.

The fibres cannot be differentiated into primary and secondary, either by their spiculation or their size. They vary very little in size or in the number of spicules they contain, the diameter of the fibre being usually 0·09 mm., and the spicules in the fibre being 4- to 7-serial. The spicules are arranged in a very slightly plumose manner.

Scattered spicules occur in enormous numbers throughout the sponge, and lie without the slightest orientation, either with regard to the sponge itself or the spongin-fibres.

Spicules. (Text-fig. 23.)

A. Megascleres. (Text-fig. 23, A.)

The only megascleres are substylostyli. They are rather long, slender spicules, with a small and inconspicuous head. They are nearly always quite straight, but sometimes slightly and regularly curved. The average length is 0·3 mm. in the full-grown specimens, but many may be met with much shorter than this. The greatest diameter of the shaft is near its middle point, from which spot it tapers gradually towards the head at one end and to a sharp point at the other. The diameter of the spicule varies from 0·002 mm. to 0·0025 mm. at its widest point; the diameter of the head is usually 0·0025 mm. A few specimens can be found sharply pointed at each end, but these are probably immature specimens.

B. Microscleres. (Text-fig. 23, B.)

The only microscleres met with in this species are toxa. They are extremely rare, and only a very few have been seen. They are very delicate throughout their length, but strongly bowed at the centre. The length is 0·2 mm. on the average, and the diameter less than 0·0005 mm.

Locality. "Dredged in 9 fathoms from a bottom of coarse sand with shells and coral, immediately off the south-east corner of We Shubuk."

Distribution. Red Sea.

Ophlitaspongia (?) digitiformis, n. sp. (Pl. **37**. figs. 14, 15.)

There occur in the collection two specimens of this rather striking species. One of these specimens is complete, but the other consists merely of a single long cylindrical process, apparently broken off from a large specimen. Both the specimens were obtained at the same time.

The large specimen stands erect on a small oval base, which measures 35 mm. by 25 mm. The basal portion of the sponge is undivided, and is in the form of a somewhat oval cylinder, about 80 mm. high and 65 mm. in breadth at its widest point. From front to back the diameter of the cylinder never exceeds 30 mm.

From the top of this basal portion arise three large digitiform processes, of perfectly uniform diameter throughout their length, which stand upright side by side. In section these processes are circular, and two of them measure 28 mm. each in diameter; the third, which is smaller, only measures 15 mm. in diameter. The two large processes measure 230 mm. in length from base to summit. These processes do not branch, in the ordinary sense of the term, but from a swelling on the side of one of the large processes

there arises a fourth short process, which lies parallel to the others throughout its length.

The surface of the sponge is slightly irregular, being covered with low ridges or slight swellings. These prominences occur both on the basal undivided portion of the sponge and also on the digitiform processes. They are arranged quite irregularly, and entirely without relation to each other.

The actual surface of the sponge is quite smooth and covered with a very delicate dermal membrane, which is not supported by a spicular skeleton. This dermal membrane has been rubbed off in many places, and here the surface appears finely reticulate with apertures between the meshes.

The oscula are very numerous and occur all over the surface of the specimen, their arrangement being quite irregular. On the large processes as many as 20–25 oscula occur, and about the same number on the undivided basal portion of the sponge. They are fairly large, and measure 5 mm. or 6 mm. in diameter. An oscular sphincter membrane can be seen in some cases. The pores are small, very numerous, and scattered over the whole surface of the sponge.

The texture of the sponge is like that of *Euspongia*; it is firm, very tough indeed, and difficult to cut, but easily compressible and also resilient. The sponge is also very soft to the touch.

The colour is dark brown throughout the sponge in spirit.

Skeleton arrangement. (Pl. **37**. fig. 15.)

The skeleton consists of a very fine-meshed network of spicule-cored spongin-fibre, the meshes of which are of but little greater diameter than the the length of a spicule.

Radial primary fibres can be distinguished, in which the spicules usually lie 3- to 4-serial, and these primary fibres occur regularly throughout the sponge about 0·12 to 0·2 mm. apart. They run straight from the centre to the circumference of the sponge, and occasionally divide into two. Occasionally smaller primary fibres arise from these, in which the spicules are only 2- or 3-serial, but as these separate from the parent fibre they become larger, and then take on the characters of the primary fibres themselves.

Between these primary fibres there is an elaborate reticulation of secondary fibre, usually with the spicules lying uniserially, which forms an extremely regularly rectangular meshwork, the diameter of the meshes of which varies from 0·12 mm. to 0·16 mm. These fibres are but little less in diameter than the primary fibres, as the spongin is considerably more developed in comparison.

A few spicules are scattered here and there outside the fibres.

There is no special cortical skeleton.

Spicules.

The spicules consist entirely of megascleres and are extremely slender. They are nearly always styli, but considerable numbers of oxea also occur, and the smallness of the diameter of the spicule frequently makes it very difficult to distinguish between them. They vary in length from 0·11 mm. to 0·13 mm., and average 0·0025 mm. in diameter.

Spongin.

Spongin is present in large quantity, the fibres being usually fully 0·04 mm. in diameter.

Locality. The two specimens were obtained at Shab-ul-Shubuk.
Distribution. Red Sea.

Sub-Family TEDANIINÆ.

Desmacidonidæ in which the megascleres are tylota and which do not possess echinating spicules.

TEDANIA ASSABENSIS, *Keller.*

Synonymy :—
1891. *Tedania assabensis,* Keller (**18**).
1892. *Tedania* sp., Topsent (**32**).

This species is represented by three large and complete specimens and a considerable number of fragments. The complete specimens are large, sub-spherical, cushion-like masses, whose diameter is about 120 mm., and whose height, from base to summit, is 80 mm. The under surface is smooth but slightly corrugated, but the upper surface is covered with the small foliaceous processes which are characteristic of the species. The fragments are, as a rule, about 25 to 30 mm. each way, and do not possess either the shape or the characteristic processes of the larger examples. That they belong to the same species as the complete specimens is, however, made evident by their spiculation.

The colour of the sponge in life has been noted by Mr. Crossland in the case of the complete specimens as "vermilion." The specimens described by Topsent (**32**), but not specifically named by him, are similarly coloured, in this case the term employed to describe the shade being "orangées," and, I think, without any doubt, belong to this species, as Topsent himself suggests. The colour of the specimens in the Crossland collection in spirit is white.

The spicules are tylota, with their swollen ends minutely spined.

Localities. Suez mud-flats (complete specimens), Suakin (fragments).
Distribution. Red Sea ; Bay of Jibouti.

Family AXINELLIDÆ.

Sigmatotetraxonida in which the microscleres have usually been entirely lost by degeneration ; the megascleres are usually, in part or entirely, stylote ; the skeleton arrangement is usually, but not always, plumose ; and there are no spined echinating styli.

HYMENIACIDON CALCIFERA, n. sp. (Pl. **38**. fig. 19 ; Text-fig. 24.)

There are two specimens of this new species in the collection, each of them growing over a mass of calcareous Lamellibranch shells and coral. The sponge forms a rather thin sheet over the coral and shells and is easily stripped off. The largest specimen measures 50 mm. by 50 mm. The film of sponge varies from 1 to 6 or 8 mm. thick.

The surface (Pl. **38**. fig. 19) is irregular, and covered with slight prominences and depressions, and also exhibits in parts a coarse and very irregular reticulate appearance, due to the skeleton arrangement. An examination of the photograph will, however, convey a better impression of the appearance of the surface than a written description possibly can.

The oscula are fairly numerous, usually rather small, and scattered irregularly over the surface. Here and there large oscula occur measuring 3 mm. to 5 mm. in diameter, but the average size of the oscula does not exceed 1 mm.

The pores are very numerous and are not confined to special pore-areas. In some parts of the sponge no pores could be seen, but in others they were very plentiful, especially in those parts of the specimen which had a reticulate appearance. They are very small, and do not exceed 0·1 mm. in diameter.

The colour of the sponge in spirit was a clear chalk-white.

The texture is rather lax, and the film of sponge when stripped from its support is limp and easily injured.

Skeleton arrangement.

The main skeleton consists of an irregular reticulation of spicule-fibres, which are quite small and scattered in most parts of the sponge, but which here and there in the sponge are much larger and form a definite, but irregular reticulation. In this case the spicules composing the fibre may be as many as 10- to 15-serial, but usually they do not lie more than 5-serial in the fibre. At the surface these fibres usually project very slightly.

The most curious and characteristic feature of the sponge lies in the fact that there is a distinct dermal skeleton formed of calcareous aster-like spicules. These form a dense and regular covering over almost the whole surface of the sponge, and apparently never lie more than one thick. It does not seem reasonable to suppose that these spicules are formed by the

sponge, and one can only suppose that they are foreign bodies taken up by this sponge as others take up sand-grains for the same purpose. A noticeable difference between the two cases occurs, however, in the fact that these calcareous spicules occur well below the dermal membrane, and not as a superficial layer at the surface of the sponge.

A careful examination of the whole specimen has entirely failed to find any animal at all which might have produced these spicules, but Mr. Crossland's notes (quoted below) show that compound Ascidians occur here as well.

Fig. 24. *Hymeniacidon calcifera.* Spicules, × 350.

Spicules. (Text-fig. 24.)

The spicules of the sponge (omitting the dermal calcareous asters) are all tylostyles, with usually a straight shaft and well-developed oval head. The shaft tapers very gradually from its thickest part, which is about the middle of the spicule, towards the head, and rather more sharply (though still gently) to the pointed end.

The spicules vary from 0·1 mm. to 0·15 mm. in length, and average about 0·0015 mm. to 0·0025 mm. in diameter.

Calcareous asters.

These bodies vary very much in the number of rays they possess, some only possessing 6 or 8 rays, while in others there may be 50 or even more. They are much more like some of the calcareous asters of some Ascidians than like the siliceous asters of the Astrotetraxonida. They vary in diameter from 0·016 mm. to 0·022 mm.

Locality. "From the under side of a buoy in Suakin Harbour. They, with Compound Ascidians and Barnacles, here enter into competition with *M. vulgaris* (Pearl Oyster) and prevent its attaining a profitable age."

Distribution. Red Sea.

HYMENIACIDON ZOSTERÆ, n. sp. (Text-fig. 25.)

This new species is represented by several specimens, all growing on the stems of Zostera plants, and usually at the nodes.

The largest specimen is a small, rather irregular, but somewhat rounded mass, which is growing in a fork of the stem, and evidently gradually spreading up and down the stems of its support. The greatest diameter of the mass is about 25 mm.

The surface is smooth, but here and there spicular fibres project, which are easily visible to the naked eye, and which may project a considerable distance.

The oscula are numerous but small, and do not measure more than

1·0 mm. in diameter, as a rule. They occur scattered in considerable numbers over the whole surface.

Fig. 25. *Hymeniacidon zosteræ.* Spicules, × 350.

The pores are very small, irregularly scattered over the surface, but not grouped into special pore-areas.

The colour of the sponge in spirit is a dark grey-brown.

The texture is very lax and the whole sponge very easily damaged.

Skeleton arrangement.

The skeleton consists of spicular fibres very irregularly arranged, and lying quite unoriented in the sponge. As a rule, these fibres contain only five or six rows of spicules, but here and there they form dense spicule-bands, which may contain as many as 50 or even more rows of spicules. There is no special dermal skeleton.

Spicules. (Text-fig. 25.)

The only spicules occurring in the sponge are tylostyles, with well-developed heads. They average 0·02 mm. in length and 0·0025 mm. in diameter. The head measures 0·004 mm. in diameter.

Locality. Mersa Wadi Lehami, Egyptian coast.

Distribution. Red Sea.

ACANTHELLA AURANTIACA, *Keller.*

Synonymy:—

1891. *Acanthella aurantiaca,* Keller (**18**).
1904. *Acanthella aurantiaca,* Dendy (**11**).

A single specimen of this species is preserved in the collection. It consists of three or four irregular lamellæ, growing adjacent to each other and attached by their contiguous surfaces to each other at frequent intervals. It is thus somewhat difficult to distinguish the various lamellæ from each other.

The sponge is 80 mm. high and 50 mm. wide. The lamellæ vary in thickness from 3 mm. to 5 mm.

The skeleton arrangement and the measurements of the spicules are exactly similar to Keller's description.

Locality. "From shallow water of the inner parts of Suakin Harbour, particularly the cove north-west of Condenser Island."

Distribution. Red Sea, Ceylon.

PHAKELLIA DONNANI (*Bowerbank*). (Pl. **38.** fig. 16.)

Synonymy :—
1873. *Isodictya donnani*, Bowerbank (**2**).
1887. *Axinella donnani*, Dendy (**12**).
1904. *Phakellia donnani*, Dendy (**11**).

Two very small specimens, both of them cup-shaped, occur in the collection. The largest has been photographed (Pl. **38.** fig. 16), and it measures 14 mm. in height and 14 mm. in diameter at the widest part of the cup.

The general appearance of both specimens is similar to the specimens described from Ceylon by Dendy (**11**).

Locality. The labels in the bottle containing these sponges were completely macerated, but there seems to be some evidence in favour of the opinion that they were obtained at Cape Elba. Out of the 56 bottles in which the sponges of the Crossland collection were sent to me, 23 were indicated on the labels inside the bottles merely by a number, and with them were sent MSS. notes relating to these numbered bottles. The numbers in the MSS. ran from 1 to 24, but only nos. 1–18 and 20–24 were present in the bottles themselves. The remaining 33 bottles were labelled as follows: one had the labels macerated, and is now being discussed, the other 32 had MSS. notes on the labels in the bottles stating the spot where the specimens were obtained &c. There is therefore a considerable possibility that this bottle with macerated labels is the missing no. 19, which was described in the MSS. as "From a piece of coral, brought up from 10 fathoms by a fishing-line, near a reef off Cape Elba, Egyptian Sudan Frontier."

Distribution. Red Sea ; Ceylon ; Madras.

PHAKELLIA PALMATA, n. sp. (Pl. **39.** figs. 20, 21 ; Text-fig. 26.)

This new species has been created for the reception of a single specimen. It consists (Pl. **39.** fig. 20) of a single frond-like lamella, growing upright on a cylindrical stalk. The base of the sponge is a flat circular area, but there are no remaining indications of the actual support. From this there arises a short stalk, circular in section, and about 10 mm. high and 6 mm. in diameter. The main body of the sponge is a broad, flat lamella, 50 mm. wide, 40 mm. high, and from 3 mm. to 5 mm. thick. From the edge of this lamella a number of very short conical processes arise, some of them merely slight protuberances from the sponge, some of them 5 mm. or 6 mm. in height. At the summit of each of these are the oscula, which are thus arranged around the edge of the sponge lamella, on special oscular processes. No oscula occur in any other position in the sponge.

The surface of the sponge is coarse and uneven ; small ridges and irregularities occur all over it, none of them definite enough to disturb the general

level of the surface, but sufficiently marked to prevent its appearing smooth. The photograph gives a very definite indication of this appearance.

The pores are difficult to see, but appear to be irregularly scattered all over the sponge surface, and not in pore-areas.

The colour of the specimen is dark brown.

The texture is very firm and tough, almost hard. The sponge is not at all easy to cut, and difficult to bend out of shape.

Skeleton arrangement. (Pl. **39.** fig. 21.)

The main skeleton consists of a large number of spicules not arranged in bundles, but all definitely oriented in the sponge. The direction in which the spicules lie is an obliquely radial one, partially pointing towards the side of the sponge lamella, and partly towards its edge. As the spicules approach the surface they become more and more nearly perpendicular to it, but as a rule never actually attain to the completely vertical position.

At the surface of the sponge there occur bundles of spicules, arranged at intervals of 0·2 mm. to 0·5 mm., instead of the scattered spicules of the general skeleton. These bundles vary considerably in size, and may contain any number of spicules from 6 or 8 to 20. The ends of the fibres project slightly from the surface and render it minutely hispid.

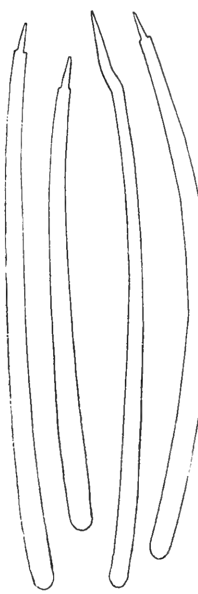


Fig. 26.—*Phakellia palmata.* Spicules, ×250.

Spicules. (Text-fig. 26.)

The only spicules which occur in the sponge are styli. They vary very considerably in size and shape, from straight to strongly curved, and from 0·2 mm. to 0·35 mm. in length. An average length is about 0·3 mm. Their greatest diameter occurs near the rounded end, from which point they taper very gradually indeed for the major portion of their length and more rapidly in the last part. The actual end is usually irregular, and frequently possesses the typical Axinellid end. The diameter of the largest specimens does not exceed 0·008 mm., and most are not more than 0·005 mm.

Locality. The specimen occurred in the bottle with macerated labels, with *Phakellia donnani.* It is therefore uncertain where the sponge was obtained, but it was possibly off Cape Elba. (For the reasons for assigning this locality to the specimen, see *Phakellia donnani*, p. 357.)

Distribution. Red Sea.

CIOCALYPTA TYLERI, *Bowerbank.*

Synonymy :—
1873. *Ciocalypta tyleri,* Bowerbank (**3**).
1904. *Ciocalypta tyleri,* Dendy (**11**).

There are several specimens of this species in the collection. Two of these are complete, the rest being more or less fragmentary. The complete specimens are each in the form of a subspherical cushion, from which the finger-like processes characteristic of the genus arise. The largest specimen measures 50 mm. in diameter, and the basal cushion-like mass is 35 mm. thick. The processes are very numerous, and vary in length from 25 mm. to 60 mm. Their average diameter at the base is 4 mm.

The skeleton arrangement and the spicule measurements are of the type ordinarily met with in this well-known species.

Another specimen, also assigned to this species, consists of a number of processes (about 20) united together at frequent intervals, and considerably larger than those of the typical specimens given above. They measure 105 mm. long, and average 6 mm. in diameter at their widest point. They taper gradually towards each end from the middle of their length, and show no signs of any attachment surface, either to the rest of the specimen or to a support.

The colour of all the specimens is white in spirit.

The skeleton and spicules are exactly similar in all these specimens to the type of this species.

Locality. Trawled at Khor Dongonab, north of the Barrier, from very barren mud in 20 fathoms.

Distribution. Red Sea ; Ceylon.

Order EUCERATOSA.

Non-calcareous sponges without siliceous spicules, but with a skeleton consisting of horny fibres developed independently, *i. e.*, not in relation to any previously existing spicular skeleton. (The skeleton is sometimes replaced or supplemented to a greater or less extent by foreign bodies.)

Family APLYSILLIDÆ.

Euceratosa with a dendritic or reticulate skeleton composed of spongin-fibres containing a more or less distinct pith, but usually without foreign inclusions ; sometimes also with isolated spicules of spongin ; with a lacunar canal-system and large sac-shaped flagellate chambers opening by wide mouths direct into wide exhalant lacunæ.

MEGALOPASTAS ERECTUS, n. sp.

The single specimen that was obtained of this new species is a small upright sponge, in the form of a rather wide and fairly thick mass. It is formed of a number of lobes, all more or less fused together and of irregular shape and varying size, and measures 65 mm. wide, 40 mm. high, and from 8 mm. to 20 mm. thick from side to side. The specimen is thickest at the centre, and gradually thins out to the sides.

The surface is covered with small conuli, from the summits of which the fibres of the skeleton project. They are very small and scattered irregularly over the whole surface. They do not exceed 1·0 mm. in height.

The oscula are very few and irregularly scattered over the sponge. They measure about 3 mm. to 4 mm. in diameter.

The pores were not distinguishable.

The colour of the sponge in spirit is deep violet.

The texture of the sponge is firm and gelatinous, yet easily broken.

Skeletal arrangement.

The skeleton is intermediate between that of a typical *Dendrilla*, in which there is a tree-like skeleton, and that of a typical *Megalopastas*, in which there is a reticulate skeleton. In the most typical members of the latter genus this skeletal reticulation is very regular, and primary and secondary fibres are clearly differentiated.

In the species now under consideration there are no distinct primary and secondary fibres and the reticulation is quite irregular; in fact, it is only after considerable hesitation that the species has been placed in *Megalopastas* rather than in *Dendrilla*. The skeleton consists of fairly large fibres, which branch very frequently and anastomose with each other here and there. No definite or average size can be given for the meshes of the reticulation thus formed, as the size varies enormously, and sometimes long stretches of skeleton-fibre occur without any anastomoses at all.

The fibres are solid, and do not possess a core of foreign bodies; they vary considerably in size, but do not seem to exceed 0·11 mm. in diameter.

Canal-system and Chambers.

The whole sponge is traversed by very many wide canals, so that in section it appears almost cavernous. These canals run in a direction approximating to the radial, down into the sponge, though the actual direction of the canal must necessarily vary as it branches.

The chambers are wide and elongated, and occur in large numbers throughout the sponge. They measure 0·2 mm. long at the maximum, by 0·04 mm. wide. They open by wide mouths direct into the large exhalant canals.

There is practically no cortex, but a slight thickening of the dermal membrane and a little mesoglœa just beneath it. There is very little mesoglœa throughout the sponge, almost the whole of the sponge being filled with chambers or occupied with canals. Here and there, however, one finds a small tract of mesoglœa ; it is clear, not granular, and contains large numbers of small stellate cells.

Locality. "From beneath a floating stage in Suez Docks."
Distribution. Red Sea.

DARWINELLA AUREA (?), *Müller.*

Synonymy:—
1865. *Darwinella aurea,* Müller (**21**).
1889. *Darwinella aurea,* Poléjaeff (**22**).
1889. *Darwinella aurea,* Lendenfeld (**20**).

There is a single rather fragmentary specimen in the collection, which has been assigned to this species. It forms a thin sheet over a portion of a mussel-shell. The preservation was not good enough for minute study or even to permit of certain specific identification.

Locality. From a buoy in Suez Bay.
Distribution. Red Sea ; Mediterranean ; coast of Spain ; S. America.

Family SPONGELIIDÆ.

Euceratosa with a (usually) reticulate skeleton of horny fibres, without distinct pith, but containing foreign bodies ; or with a skeleton composed of foreign bodies united together by little if any spongin. With lacunar canal-system, and large sac-shaped flagellate chambers opening directly by wide mouths into wide exhalant lacunæ.

SPONGELIA ÆDIFICANDA, n. sp.

The material on which the new species is founded is all fragmentary, though considerable. It consists of a large number of pieces, evidently cut off from a large specimen, each fragment containing a barnacle or sometimes two or three. There is thus considerable difficulty in describing the external form, and the best course seems to be to describe three or four of the fragments which are the largest, and to build up from those descriptions as much as possible of the external appearance.

Fragment 1.—A strap-shaped, bluntly-ending terminal portion of a branch, measuring 30 mm. long, 12 mm. wide, and 1·5 mm. to 2 mm. thick. It contains two barnacles, each forming a subspherical swelling about 6 mm. in diameter, near the edge of the specimen.

Fragment 2.—A long, irregularly cylindrical process, with branches arising from it. It varies in diameter at different points from 8 mm. to 2 mm.

At the point where the specimen measures 8 mm. in diameter two barnacles occur, and at the same point five branches arise from the stem, in varying direction and of different size.

Fragment 3.—A small fragment consisting of a group of nearly cylindrical branches, which branch and anastomose with one another. At one point there are 3 barnacles close together. The various branches have a diameter of from 3 mm. to 5 mm.

Other fragments, which are for the most part smaller than the ones above described, show intermediate conditions between those of these three fragments. In some cases strap-shaped branches arise from cylindrical ones, and in one case a strap-shaped branch suddenly becomes cylindical in shape. It is noteworthy that the barnacles usually grow at the point of junction of two or more branches, but sometimes they occupy other positions.

The barnacles themselves always occupy small cavities, measuring about 3 mm. in diameter, within the sponge. This causes a swelling to appear on the surface of the sponge, as noted above, which measures usually about 6 mm. in diameter, and which has a small aperture at one point by which the barnacle is able to protrude its tentacles to the exterior. The inside wall of the cavity containing the barnacle is quite smooth and shows no sign of either pores and oscula.

That the chambers in which the cirripede lives are formed by the upgrowth of the sponge around it, and not by hollowing out of already formed tissue, is clear from the following :—A section cut through the swelling just above one of the barnacles, which was lodged in the cleft between two branches, showed the following structure. The two branches, and their skeletons, were clearly shown in the section, and between them was a mass of tissue noticeably different in skeletal structure, both in size and arrangement of the fibres. This seems to render certain that the barnacle settles down on some already formed part of the sponge, and that a secondary growth of tissue takes place around it. Further, it does not seem possible that the relationship of sponge and barnacle should be accidental, for this formation of secondary tissue, in scores of cases, to form a well-defined and regular investment for the barnacle, always of about the same diameter and always furnished with the same small aperture, seems definitely to indicate that the connection of the two animals is symbiotic.

The surface of the sponge is quite smooth, and no projections whatever occur on it.

The oscula are small, few in number, and, as far as can be ascertained from the material available, irregularly scattered over the whole of the sponge surface. They average 1·0 mm. in diameter.

The pores are very numerous, and frequently occur in rows above the inhalant canals. No definite pore-areas are marked out, however.

The colour in spirit is a brownish white.

Skeleton arrangement.

The skeleton consists of a reticulation of spongin-fibre covered with foreign bodies, and there is also a thin and rather scanty dermal coating of small sand-grains. The structure of the spongin-fibres and their arrangement differ considerably in the regular branches of the sponge and in the secondarily formed tissue around the barnacles.

The fibres in branches themselves can be distinguished roughly into primary and secondary fibres, according as they possess a core of foreign bodies or not. The average diameter of the main fibres is 0·1 mm., and the core within them usually measures about 0·07 mm.

The foreign bodies which form the fibre-core seem to have undergone some peculiar change; they do not seem to possess any definite shape, but all lie fused up together into a continuous and irregular cylinder. In a very few places it is possible to see a few sand-grains clearly marked out from the surrounding confused mass, but, as a rule, it is quite impossible to ascertain what the various foreign bodies are.

The fibres are not always cored; sometimes the core stops quite suddenly, and in these cases the distinction between primary and secondary fibres breaks down, or else a primary fibre becomes a secondary.

The primary fibres branch and run fairly regularly. The reticulation formed by them and the secondary fibres is rather irregular in the centre of the sponge, but at the surface they form an extremely regular meshwork whose meshes are rectangular; the primary fibres are not quite so thick here as in the middle of the branch. The secondary fibres have no foreign bodies within them, and are very much slenderer than the primary fibres, measuring only 0·015 mm. to 0·02 mm. in diameter.

The fibres in the secondarily formed tissue are midway between the primary and secondary fibres of the true branches in point of size, measuring from 0·03 mm. to 0·05 mm. in diameter, but the most striking difference lies in the fact that in these latter fibres the foreign bodies, chiefly sand-grains, of the core are quite distinct, and not fused up together at all. The reticulation that they form is fairly regular, but not definitely oriented to the sponge surface.

Canal-system and Chambers.

The pores lead direct into large horizontal subdermal canals, from which large inhalant canals lead into the interior of the sponge. These canals ramify throughout the sponge, and cause the interior of the sponge to appear very cavernous. They measure from 0·3 mm. to 0·4 mm. in diameter.

The chambers are eurypylous, and measure 0·06 mm. to 0·07 mm. in diameter. They open direct into the exhalant canals, which are similar to the inhalant.

The mesoglœa is abundant, and is filled with cells, which are mostly stellate, though some appear circular. The mesoglœa is not granular, and there are no fibres or pigment-cells.

Locality. Not stated.
Distribution. Red Sea.

SPONGELIA DELICATULA, n. sp.

The single specimen obtained of this species consists of a group of small flat branches, which are irregularly lobed or slightly branched, and usually more or less strap-shaped. They are thinnest at the centre of the branch, and thicken out at the sides into a ridge. The height of the branches is 55 mm., their width anything from 5 mm. to 20 mm. and their thickness from 1 mm. to 5 mm.

The surface is covered with small conuli, regularly arranged over the whole sponge surface, and each with a spongin-fibre protruding from the centre. These conuli do not exceed 0·25 mm. in height, and are about 1·0 mm. to 1·5 mm. apart.

Oscula and pores were not distinguishable.

The colour of the sponge is horn-grey in spirit.

The texture of the sponge is firm, but the sponge is not rigid, but easily bent or twisted out of shape. It immediately regains its shape when released.

Skeleton arrangement.

The skeleton consists of an irregular sparse reticulation of spongin-fibre which is always filled with sand-grains, and does not present any differentiation into primary and secondary fibres. The fibres run quite irregularly in the sponge, but all end in the conuli on the surface, of which they form the support. They measure from 0·08 mm. to 0·1 mm. in diameter.

Canal-system and Chambers.

The whole sponge is highly vacuolated, owing to the great size of the inhalant and exhalant canals. Indeed, it may be said that the tissues of the sponge merely form a series of trabeculæ between the various canals. The canals may reach any diameter up to 0·5 mm., while the sarcode between them rarely exceeds 0·2 mm.

The flagellated chambers are not easy to see and are rather scarce; they measure 0·06 mm. to 0·08 mm. in diameter; they are eurypylous and open directly into large exhalant canals. The preservation was not sufficiently good for any further details of the canal-system to be made out.

There is a cortex in the form of a narrow dermal band of fibrous tissue,

in which the fibres run tangentially. The cortex measures 0·06 mm. to 0·07 mm. in thickness.

Locality. Suakin Harbour.
Distribution. Red Sea.

Dysidea cinerea, *Keller.*

Synonymy:—
1889. *Dysidea cinerea,* Keller (**18**).

There occurs in the collection a single specimen which I identify with this species. It agrees with Keller's original description in general shape and appearance very closely, but in certain features it differs. Keller's original description of the external appearance runs as follows:—"Der Schwamm bildet massige Stücke oder Krusten von 5–10 cm. im Durchmesser, auf welchen sich zweilen einzelne kurze abgerundete Fortzatze erheben, deren Durchmesser etwa 1 cm. beträgt, und deren Höhe zwischen $\frac{1}{2}$–3 cm. schwankt."

The specimen now being considered forms a mass 60 mm. high and 120 mm. long by 45 mm. wide. The upper surface of the sponge is covered with short processes 10 mm. to 30 mm. high, by about 15 mm. in diameter. Several processes also occur on the sides of the specimen. So far the specimen is almost identical with Keller's, but the basal part of the sponge in my specimen is apparently formed entirely of the partly fused lower portions of the processes referred to above. There is no true undivided portion of the sponge, and the composite character of the whole is rendered evident by the fact that the spaces between the various processes are continued down into the base of the sponge, and the conuli that cover the outside surface of the sponge can also be seen at the sides of these cavities. It may be assumed therefore that the sponge consists of a mass of tubes, with their basal portions partially fused, and 10 mm. to 30 mm. free at the distal end.

The colour in spirit is pale brown.

The skeleton and the canal-system are identical with Keller's original description.

Locality. No locality is given, but the sponge was obtained at a depth of 9 fathoms.

Distribution. Red Sea.

Psammopemma commune (*Carter*).

Synonymy:—
1885. *Hircinia communis,* Carter (**6**).
1889. *Psammopemma commune,* Lendenfeld (**20**).

The present species was represented in the collection by four specimens, all of the same habit. Each consists of a mass of upright cylindrical processes, which branch and anastomose to form an irregularly but densely

reticulate mass, from the upper surface and sides of which the free distal ends of the processes protrude. The free part of the processes is on the average about 20 mm. to 25 mm. in length, and from 10 mm. to 15 mm. in diameter. The largest specimen measures 60 mm. × 50 mm. and is 65 mm. high.

The colour in spirit is dark grey.

The texture of the sponge is very brittle, and the whole sponge is easily crushed to powder.

The surface is covered with small conuli, which are usually 1 mm. to 2 mm. high, though they may be as much as 3 mm. They are as a rule 3 mm. to 4 mm. apart. These conuli are produced by the occurrence beneath them of an accumulation of sand-grains, which frequently occur at the distal ends of the skeletal sand-fibres, but sometimes unconnected with them. These aggregations of sand-grains are connected with one another by sand-fibres, which form a series of ridges running between the conuli, and cause the whole surface of the sponge to appear reticulate. These dermal sand-fibres are frequently raised considerably above the level of the sponge surface, and connected with it by a delicate vertical membrane.

The skeleton is wholly of sand. There is no definite sand-cortex, but a dermal reticulation of sand-fibres, as stated above. Sand-grains are scattered throughout the cortex.

The sand-fibres of the main skeleton are somewhat irregular in arrangement, and cannot be divided into main and secondary. They usually measure 0·2 mm. in diameter, but sometimes, usually at a spot where a very large sand-grain has been engulfed, they measure much more, and may reach 0·5 mm. in diameter.

Locality. All the specimens were obtained from 5 fathoms of water in Suakin Harbour.

Distribution. Red Sea, Australia.

Euryspongia, n. gen. (Pl. **39**. fig. 23; Pl. **41**. figs. 27, 28.)

Spongeliidæ with a reticulate skeleton, in which primary radial fibres cored with foreign bodies and secondary connecting fibres without foreign bodies can be distinguished.

This new genus has been necessitated by the presence in the collection of a sponge with Spongelid canal-system and eurypylous chambers, but with a skeleton exactly similar to that of *Euspongia irregularis.*

Euryspongia lactea, sp. n. (Pl. **39**. fig. 23; Pl. **41**. figs. 27, 28.)

The species is represented by two large specimens, which form somewhat irregular, subspherical cushions, growing probably on mud. They are of

almost identical size, though one of them is somewhat flatter in shape than the other. The largest measures 130 mm. in diameter and 100 mm. high.

The surface (Pl. **39.** fig. 23) is covered with conuli crowded together very closely. They measure from 1 mm. to 2 mm. high in different parts of the sponge, and are usually about 2 mm. to 3 mm. apart, though in some parts of the specimens they are even closer together. They are frequently connected together by low ridges, so that the whole surface is divided up into meshes by them. From their summits the primary fibres of the skeleton project, often branching outside the surface of the sponge.

The oscula are numerous and very variable in size ; they are scattered at irregular intervals over the whole surface. They measure from 3 mm. to 10 mm. in diameter.

The pores are minute, and occur in the meshes formed by the ridges running between the conuli, and thus the meshes are a kind of pore-area. In some parts of the sponge the pores could not be seen.

The colour of the sponge is milky white, due to the enormous quantities of fine grey-white mud which the sponge has swallowed.

The texture is soft, and the sponge is easily compressible, but quite tough.

Skeleton arrangement. (Pl. **41.** fig. 27.)

The skeleton is exactly similar to that of *Euspongia irregularis*. There is a definite and fairly regular reticulation of spongin-fibres. The main fibres run radially, but not quite straight, and measure 0·08 mm. in diameter. They are filled with foreign bodies, which are chiefly sand-grains. The secondary fibres are very delicate, and form an irregular reticulation between the primary fibres ; they do not contain any foreign bodies whatsoever. They vary considerably in size, all sizes between 0·014 mm. in diameter and 0·03 mm. being found. The meshwork formed is quite irregular, and no average size of the mesh can be given.

Canal-system and Chambers. (Pl. **41.** fig. 28.)

The pores lead directly into a series of horizontal, small canals lying in the cortex, which open into large subdermal cavities. These subdermal cavities lie quite irregularly in the superficial parts of the sponge, and some of them are of enormous size, while others are quite small. From them inhalant canals run steeply down into the interior of the sponge.

The chambers are large, sac-shaped, and eurypylous ; they open by wide mouths into large exhalant canals. The mouth is frequently the largest part of the chamber, which measures 0·08 mm. to 0·1 mm. in diameter.

The canals in the interior of the sponge are sometimes very large, examples being frequently seen in the sponge 5 mm. or 6 mm. in diameter.

Histology.

There is no true cortex as such, but a dermal layer occurs in which chambers are very scarce, and which is filled with cells, usually stellate in shape.

The whole ground-substance of the sponge is filled with particles of mud and débris, taken in by the sponge. This foreign matter is not specially frequent (or specially scanty) in any spot in the whole sponge, but evenly distributed throughout, so that a considerable opacity is given to sections.

The mesoglœa is in most parts scanty, but large tracts can be found here and there, especially in the neighbourhood of the inhalant and exhalant canals. The cells of the mesoglœa are much fewer than those of the cortex, but otherwise the two tissues are very similar. In the neighbourhood of the canals strands of fibres are occasionally met with, which are very possibly muscle-fibres. The fibres run radially in direction, and form slender bands in which the fibres are not closely packed together, but separated by gelatinous ground-substance.

Locality. One specimen was obtained at Suez ; no locality is given for the other.

Distribution. Red Sea.

This species, as described above, approaches very closely indeed to the genus *Euspongia*, the only difference being in the eurypylous chambers. It is, therefore, with considerable hesitation that I have placed it among the Spongeliidæ rather than the Spongiidæ ; but this course has been taken in order to avoid breaking up the existing classification of Euceratosa by means of their canal-system. Under the present conditions, therefore, the genus *Euryspongia* is looked upon as the most highly evolved member of the family Spongeliidæ, and possibly directly on the main stem of the evolution of the Euceratosa.

At any rate, it shows how little faith can be placed in the present distinctions between the families of Euceratosa, as intermediate forms are common, and almost the whole of the gaps have now been filled up.

Another example of the same thing is shown in the two genera *Heteronema*, Keller (**18**), and *Duriella*, n. g., described below, which have been placed among the Spongiidæ on the strength of their small and diplodal chambers, while their skeleton is of an extremely primitive type and very irregular.

Family Spongiidæ.

Euceratosa with a reticulate horny skeleton and with small more or less spherical flagellate chambers, commonly provided with special narrow exhalant canaliculi. The ground-substance between the chambers is compact and densely charged with fine granules.

Heteronema erecta, *Keller*.

Synonymy:—

1889. *Heteronema erecta*, Keller (**18**).
1906. *Heteronema erecta*, Topsent (**35**).

A single specimen has been identified as this species, though only after considerable hesitation. Keller (**18**) does not state whether the flagellated chambers of his genus *Heteronema* are eurypylous or diplodal, but only gives measurements for the chambers. However, he puts his sponge into the Spongeliidæ, in which the chambers are eurypylous, as the family is now understood. My specimen, however, possesses diplodal chambers, and on that account I have removed the genus *Heteronema* from the Spongeliidæ to the Spongiidæ.

(The specimen has been cut into three slices, but they can easily be fitted together.)

The specimen consists of a group of conical protuberances of somewhat irregular shape, growing upright from a small base. The specimen measures 125 mm. long, 60 mm. to 70 mm. wide, and 65 mm. to 75 mm. high at different points.

The surface is regularly covered with minute conuli, which average 0·3 mm. in height and are 1·0 mm. to 1·5 mm. apart. These indicate the ends of the primary fibres of the skeleton. They are connected by series of ridges radiating between the conuli.

The oscula are fairly numerous, and measure 2 mm. to 3 mm. in diameter.

The pores were not seen on most of the sponge, but in some parts they could be distinguished in the meshes between the ridges connecting the conuli.

The colour is black-brown on the outside of the sponge and a dark brown inside.

The texture is firm, hard, and incompressible.

The skeleton consists of a coarse but regular reticulation of spongin-fibre, filled with foreign bodies, chiefly sand-grains, and can be differentiated into primary and secondary fibres. The primary fibres run radially, and the secondary fibres form a rectangular meshwork with them.

The whole skeleton is exactly like that described by Keller, as is also the canal-system, save that Keller omits to state whether the chambers of his species are diplodal or eurystomous. In the specimen now under consideration they are diplodal and measure 0·03 mm. to 0·038 mm. in diameter.

Locality. Sherm Sheikh.

Distribution. Red Sea, Gulf of Aden.

Duriella, n. gen. (Pl. **41**. fig. 29.)

Spongiidæ in which the skeleton is composed of an irregular reticulation of spongin-fibre, which forms lax trellis-like groups of fibres instead of simple fibres.

The present genus is an unsatisfactory one, but the specimens for which it has been created would not go into any of the previously named genera without considerably widening the generic diagnosis. Its nearest ally is undoubtedly *Heteronema*, but it differs from the latter genus principally in its much less regular skeleton, which has apparently undergone partial degeneration in *Duriella*. Here a very wide-meshed network is marked out by what I propose to call "fibre-lines" composed not of one fibre, but of a very irregular reticulation of small fibres. At the junctions of the various fibre-lines a considerable increase in the thickness of the fibres occurs, and also an increase in the number of fibres, which widen out into a system of diagonal connecting-fibres between the main "fibre-lines."

Duriella nigra, n. sp. (Pl. **41.** fig. 29.)

The single specimen consists of two irregular upright somewhat cylindrical processes varying in different parts from 20 mm. to 30 mm. in diameter and 135 mm. high.

The surface is minutely conulose, very like that of *Heteronema erecta*, with conuli 0·5 mm. to 1·0 mm. high, and 1·0 mm. to 1·5 mm. apart. As in *Heteronema*, these conuli are connected with one another by a series of ridges radiating from each one, so that the surface presents a minutely reticulate appearance.

The oscula are numerous, and occur scattered about the surface of the sponge promiscuously and irregularly. They measure 3 mm. to 4 mm. in diameter.

The pores occur thickly scattered over the surface of the sponge, in the meshes between the ridges connecting the conuli.

The skeleton consists of an irregular, very wide reticulation of "fibre-lines," the mesh averaging 2 mm. to 3 mm. across. The fibres composing the "fibre-lines" are arranged very irregularly in the "line" and vary enormously in size, fibres of all diameters from 0·03 mm. to 0·3 mm. being found. As a rule, the thickest fibres are found near the junction of the radial and tangential "fibre-lines."

At the surface of the sponge there is a tangential reticulation of fibres, which is arranged rather more regularly than those in the interior of the sponge. The external evidences of this reticulation can be seen in the ridges radiating from the conuli. The conuli themselves are the meeting-points of a large number of fibres, each of which underlies a ridge. Between these fibres there run very numerous smaller fibres which do not show on the surface. The general average of size of the fibres is higher in the dermal reticulation than in the skeleton of the sponge interior, but the individual fibres of the former do not exceed those of the latter in size.

All the fibres are full of foreign bodies such as sand-grains, sponge-spicules, and Radiolaria skeletons.

Canal-system and Chambers.

There are no definite subdermal cavities in this species, but the pores open into narrow canals, which run tangentially in the cortex and open into large inhalant canals leading down into the interior of the sponge. These inhalant canals vary in size from 0·05 mm. to 0·4 mm. in diameter.

The chambers are small, diplodal, and they measure 0·04 mm. in diameter as a maximum. They occur in enormous numbers, forming dense masses separated by tracts of mesoglœa.

The exhalant canals could not be distinguished from the inhalant.

Histology.

The preservation of the specimen is very poor, so that but little could be made out of the histology.

The mesoglœa consists of tracts here and there, chiefly in the region of the large canals, either exhalant or inhalant. These tracts are frequently very fibrous, with the fibres very irregularly arranged, but mostly longitudinally, along the wall of the canal. Sometimes the fibres are crowded together in a mass, sometimes the fibres are very scanty, and they may merely consist of a few strung across a plain mesoglœa.

The cellular elements in the mesoglœa are scanty, and the cells are nearly all spherical, a few stellate cells occurring here and there.

Pigment.

The sponge contains enormous numbers of pigment-cells, containing a black pigment, throughout the whole of the sponge. The greatest numbers of them occur in the ectoderm, where they are densely filled with the colouring-matter; but they also occur in the deepest parts of the sponge, though here not in such large numbers and not so deeply pigmented.

Locality. Suakin Harbour.
Distribution. Red Sea.

HIRCINIA VARIABILIS, var. TYPICA, *Schmidt.*

Synonymy:—
1879. *Hircinia variabilis,* Schulze (26 *a*).
1862. *Hircinia typica,* Schmidt (26).
1889. *Hircinia variabilis,* var. *typica,* Lendenfeld (20).

One small specimen of this variety occurs in the collection, measuring 45 mm. by 28 mm., and 27 mm. in height.

The colour is dark grey.

The surface is conulose, the conuli being on the average 2 mm. high and irregularly scattered over the sponge surface.

The skeleton is quite free from foreign bodies, and agrees very closely with the original description.

Locality. Suakin Harbour.

Distribution. Red Sea, Mediterranean, East Coast of North America, Australia.

HIRCINIA VARIABILIS, var. HIRSUTA, *Schmidt.*

Synonymy:—

1879. *Hircinia variabilis,* Schulze (**26** *a*).

1862. *Hircinia hirsuta,* Schmidt (**26**).

1889. *Hircinia variabilis,* var. *hirsuta,* Lendenfeld (**20**).

A single large specimen has been assigned to this variety, though the external form differs somewhat from the description given by Lendenfeld (**20**).

The present specimen consists of a fairly thick encrusting mass, which probably grew over some coral, as fragments of coral are still attached to it. The average thickness of the specimen is 5 mm., but at one place, near the edge of the sponge, a thickening occurs to 15 mm. This was probably the result of a depression in the substance on which the sponge grew, as the upper surface of the sponge is quite level. At the immediate edge the sponge rapidly thins out to nothing.

No oscula were to be observed on the sponge.

The surface of the sponge is covered with conuli, which are large and very conspicuous. They average 8 mm. high, and are about 10 mm. in diameter at the base. In some parts of the sponge they lie quite close together, while in other parts they are not only less frequent, but also smaller.

From the summit of each conulus one of the main fibres of the skeleton very slightly projects.

The colour of the sponge is a dark brown-grey in spirit.

The skeleton is extremely similar to the description given by Lendenfeld (**20**) for the variety. There are enormous numbers of "*Hircinia* fibres."

Locality. Shab-ul-Shubuk.

Distribution. Red Sea, Mediterranean, Indian Ocean, Australasia.

HIRCINIA RAMOSA, *Keller.*

Synonymy:—

1889. *Hircinia ramosa,* Keller (**18**).

There is a single specimen of this species in the collection, and it forms a rather small encrusting sheet, detached entirely from any support.

The surface is covered with small conuli 2 mm. to 3 mm. high, irregularly and rather sparsely scattered over the whole sponge surface.

The colour in spirit is yellowish white.

The skeleton agrees closely with the original description, and is quite free from foreign bodies.

Locality. The single specimen was obtained from the north-west of Condenser Island, Suakin Harbour.

Distribution. Red Sea.

HIRCINIA RUGOSA, *Lendenfeld*.

Synonymy:—

1889. *Hircinia rugosa*, Lendenfeld (**20**).

This species is represented by three fragments of quite irregular shape, but which were probably all encrusting. No definite external characters can be given, owing to their fragmentary condition.

The colour of the specimens was greyish white, due to the presence of a dense sand-layer in the cortex.

The whole skeleton consists of sand. There is an extremely dense dermal layer of sand varying, in different parts of the specimen, from 0·6 mm. to 0·9 mm. thick. Further, the whole sponge is full of sand, in irregular bands and tracts which no longer possess the appearance of fibres. The grains of sand in these tracts are very dense towards the centre of the tract, but thin out somewhat towards its edge. Sand-grains are scattered thickly also between these tracts.

No details of the canal-system could be made out.

Locality. All the specimens were obtained from the north-west of Condenser Island, Suakin Harbour.

Distribution. Red Sea, Australia.

HIRCINIA FASCICULATA (*Esper*).

Synonymy:—

1791. *Spongia fasciculata*, Esper (**14**).
1889. *Hircinia fasciculata*, Lendenfeld (**20**).

This species is represented by a single large fragment, which is only a portion of a specimen. It forms a large erect mass 100 mm. by 20 mm., and is 55 mm. high, but the external surface of the sponge is only visible over a very small portion of the specimen. Where it can be seen, however, it is covered with low conuli, 1 mm. to 1·5 mm. high, irregularly scattered over the surface at distances varying from 5 mm. to 15 mm.

The colour of the specimen is deep brown in spirit.

The skeleton agrees exactly with the original description. The trellis-like main fibres contain considerable quantities of foreign bodies, chiefly sand.

Locality. The single specimen was obtained from the north-west of Condenser Island, Suakin Harbour.

Distribution. Red Sea, Indian Ocean, Mediterranean.

APLYSINA INFLATA, *Carter*.

Synonymy:—
1881. *Aplysina inflata*, Carter (5).
1889. *Aplysina inflata*, Lendenfeld (20).

This curious species is represented in the collection by two fistulæ, broken off from the rest of the specimen. Each of them is partially open at one end and entirely closed at the other. Presumably the aperture at the one end is the spot where the fistula has broken away from the rest of the specimen, and this is therefore the lower end. No trace of attachment can be seen on either of the fistulæ at any part of the surface.

The height of the fistulæ is 45 mm. in one case and 100 mm. in the other; each of them varies in diameter from 15 mm. to 20 mm., but the actual sponge-wall does not exceed 1·0 mm. in diameter.

The surface of the specimen and the structure of the sponge-wall, both in skeleton arrangement and sarcode, agrees extremely closely with Carter's original description.

Locality. Sherm Sheikh.

Distribution. Red Sea, Australia.

APLYSINA PRÆTENSA, n. sp. (Pl. 36. fig. 11.)

This new species has been created for the reception of a single specimen of a form somewhat similar to that of *Aplysina inflata*, Carter, but which differs from the latter in many important characteristics, and notably in the skeleton.

The specimen (Pl. 36. fig. 11) consists of an irregular spreading mass, which is, however, very incomplete. No portion of the basal surface, or of the body to which it was attached, is present, and the specimen merely consists of a shell of variable thickness, partly surrounding a large central cavity; a considerable portion of the wall of the cavity is missing, however, and other gaps occur in the wall. The appearance of these latter apertures, which are nearly circular in shape, suggests that possibly digitiform processes have been broken away from the specimen. Also in several places low prominences and thickenings of the crust occur, which are apparently the commencement of further processes.

The sponge-wall is usually very thin, and in most parts of the sponge does not exceed 1–2 mm. in thickness, but where the hillocks and thickenings referred to above occur it may be as much as 5 mm. thick.

The surface of the sponge is covered with conuli, scattered irregularly over the sponge. They are frequently connected with other conuli by ridges, sometimes a series of them being united to form a clear upstanding ridge. They vary considerably in height, and also in frequency of occurrence, in different parts of the specimen. The average height is 2 mm. to 3 mm., and they are usually about 5 mm. to 8 mm. apart, though in some cases they are

very much closer together. From these conuli project the ends of the skeletal fibres, usually only very slightly, just so as to be apparent, but in some cases the fibre projects considerably, and occasionally branches outside the sponge.

The colour in spirit is dark purple-brown.

The texture of the sponge is firm, resistant, and not at all compressible.

The skeleton consists of an irregularly branching fibre, the junctions between the fibres being somewhat few and quite irregular. This forms the chief difference between this species and *Aplysina inflata*, in which the skeleton is regularly reticulate. The skeletal fibre cannot be distinguished into main and secondary fibres, as there is no definite distinction of either thickness or direction to be made. Very great variations in thickness occur in the fibres, and they may measure anything up to 0·6 in diameter. Other fibres were found which did not exceed 0·05 mm. thick, as well as all intermediate sizes. The anastomoses between the fibres, and also connecting fibres, were very infrequent, and almost entirely absent from the more superficial parts of the sponge.

The fibres are pithed, as is always the case in this genus, and the pith occupies usually about eight-tenths of the whole of the fibre. They are, however, entirely free from foreign bodies, as is the rest of the sponge.

The canal-system of the sponge could not be clearly made out. In most parts of the specimen flagellated chambers were not distinguishable, and the sponge consisted of mesoglœa, containing very large numbers of stellate cells, and perforated by an immense number of minute canals about 0·01 mm. in diameter. Where flagellated chambers do occur they are very small, not measuring more than 0·017 mm. in diameter, and they are by no means plentiful anywhere.

No other details of the canal-system could be made out.

Locality. "Sponges from among coral collected from the shallows at Khor Dongola."

Distribution. Red Sea.

APLYSINA RETICULATA, *Lendenfeld.*

Synonymy:—

1889. *Aplysina reticulata,* Lendenfeld (20).

A single small specimen, consisting of a very irregular, and very thick, upright lamellar sponge, 60 mm. long by 30 mm. high. At its thickest point the lamella has a diameter of 12 mm., but this diminishes to almost nothing at the summit. The upper part of the sponge is cut into a number of lobes.

The colour in spirit is dark violet.

The skeleton-fibre is large, and possesses a very well-marked pith. It measures 0·1 mm. to 0·2 mm. in diameter, of which the pith constitutes $\frac{9}{10}$. There are very few anastomoses between the fibres of the skeleton, especially

on the outside, so that it closely resembles the genus *Dendrilla* in this respect.

Locality. "Sponges from beneath a floating stage in Suez Docks."

Distribution. Red Sea ; Indian Ocean.

APLYSINA MOLLIS, n. sp. (Pl. 38. fig. 18.)

This new and rather striking species is founded on six specimens, all obtained at one time. The special characteristics of the species are its remarkable colour, apparently due to a symbiotic alga, and the very great width of the skeleton-mesh.

The largest specimen in the collection (Pl. 38. fig. 18) is an upright mass from which arise three processes at the summit of the sponge. These processes are all fairly cylindrical. The other specimens are all much smaller and one of them encloses a living Lamellibranch, apparently of the genus *Avicula*. Mr. Crossland's notes on this species contain a reference to this commensalism between the Lamellibranch and the sponge, and he states that it is of common occurrence.

All over the sponge there are slight irregularities of level, protuberances and depressions, arranged quite irregularly.

The surface of the sponge is conulose, and the conuli are very well marked and wide apart. They vary from 1 mm. to 2 mm. in height, and are about 6 mm. or 8 mm. apart. They are arranged regularly over the surface, and mark the points at which the skeletal fibres reach the surface. They are sometimes connected by more or less well-marked ridges.

The oscula are few in number and irregularly scattered. Two of the cylindrical projections from the upper part of the sponge bear oscula on their summits. They vary in size from 3 mm. to 10 mm.

The pores are always situated in small depressions on the surface, and a depression may contain one or many pores. In the latter case pore-areas are formed, or, at any rate, special aggregations of pores. They are very small and numerous, and occur over the whole sponge surface.

The colour is described by Mr. Crossland as "a very dark green on the surface, light yellow where broken." This colour changes in spirit to a uniform deep violet ! This dark green on the outside and light yellow inside is also found in *Halichondria intricata*, Topsent. In *Aplysina mollis* it seems to be due to a symbiotic alga.

Skeleton arrangement.

The skeleton consists of a few large pithed fibres only, and these fibres have very few branches and still fewer anastomoses. At the surface of the sponge they are almost always 6 mm. or 8 mm. apart. Their diameter is 0·3 mm., of which $\frac{8}{10}$ is occupied by the pith. There are no foreign bodies.

Canal-system.

Directly below the surface occur numerous small canals, which run in the superficial layers of the cortex in a tangential direction. Into them open the pores, and they themselves lead into a series of small subdermal cavities, which have a depth of about 0·07 mm. From these inhalant canals run down into the sponge, averaging 0·2 mm. wide.

The chambers are small, very numerous, and massed together in patches. They measure 0·03 in diameter.

Histology.

There can be distinguished three regions in the cortex:—

(i.) The dermal layer, measuring 0·1 mm. to 0·14 mm. in thickness, and densely packed with small stellate cells, but no apparent fibres or pigment.

(ii.) Just below the subdermal cavities the cortex is hollowed out into a large number of small elongated cavities, which are filled with long rows of round cells. These I believe to be symbiotic algæ, and if this is the case they would account for the dark green colour of the surface.

(iii.) The remainder of the cortex above the chamber-layer is not to be distinguished from the ordinary mesoglœa.

The mesoglœa is not very abundant for an *Aplysina*, and is filled with very small stellate cells.

Locality. Agig Harbour, in 4½ fathoms.
Distribution. Red Sea.

APLYSINA PURPUREA, *Carter.*

Synonymy:—
1880. *Aplysina purpurea,* Carter (**7** *a*).
1889. *Aplysina purpurea,* Dendy (**12**).
1889. *Psammopemma fuliginosum,* Lendenfeld (**20**).
? 1889. *Psammaplysilla arabica,* Keller (**18**).

A single very fragmentary specimen has been assigned to this species on the strength of the structure of its skeleton; its preservation was not sufficiently good for more to be made out of it.

Locality. Suez.
Distribution. Red Sea; Ceylon; Australia.

CACOSPONGIA CAVERNOSA (*Esper*).

Synonymy:—
1791. *Spongia cavernosa,* Esper (**14**).
1889. *Stelospongia cavernosa,* Lendenfeld (with complete synonymy) (**20**).

This species is represented by a single specimen. It is quite typical in

appearance, and the sponge-tissues are mere thin membranes covering and uniting the fibres of the skeleton.

The colour in spirit is greyish black.

Locality. Attached to a dead pearl-shell, Khor Dongonab.

Distribution. Red Sea, Mediterranean, Indian Ocean, Pacific Ocean.

PHYLLOSPONGIA MADAGASCARIENSIS (*Hyatt*).

Synonymy:—
1877. *Carteriospongia madagascariensis*, Hyatt (**16**).
1884. *Phyllospongia madagascariensis*, Ridley (**23**).

There are four specimens of this species in the collection. Each consists of a delicate mass of lamellæ arising from a common base. Three of the specimens are rather irregular in shape, but the fourth possesses the typical flower shape, being circular with the lamellæ arranged concentrically instead of parallel, and the largest lamellæ are in the centre, and the smallest outside. The complete specimen measures about 75 mm. in diameter and 30 mm. high. The average diameter of the individual lamellæ is 1·0 mm. to 1·5 mm., but a few reach 2·0 mm. in thickness.

The surface of the lamellæ is quite smooth.

The colour in spirit is dull brownish white.

The dermis is covered with minute sand-grains, but not thickly.

The fibres are similar to Hyatt's description; their diameter is 0·07 mm.

Locality. One specimen from Khor Dongonab, three from Suakin Harbour.

Distribution. Red Sea, East African region.

PHYLLOSPONGIA CORDIFOLIA (*Keller*).

Synonymy:—
1889. *Carteriospongia cordifolia*, Keller (**18**).

A single large specimen growing on a piece of coral. It consists of a considerable number of lamellæ, which stand erect and form a dense, rather irregular mass. The lamellæ are mostly rather deeply and irregularly palmatifid; but these divisions apparently do not indicate incipient branching, but only a permanently lobed condition of the lamella.

The sponge is 110 mm. high from the base to the top of the tallest lamella, and about 70 mm. wide. The lamellæ are 1·5 mm. thick.

The surface is covered with very minute spines, 0·2 mm. high and 2 mm. apart.

The colour is dull yellowish white.

The skeleton consists of a reticulation of spongin-fibre containing a very large quantity of sand-grains and some other foreign matter.

Locality. Suakin Harbour.

Distribution. Red Sea.

PHYLLOSPONGIA RADIATA (*Hyatt*).

Synonymy:—

1877. *Carteriospongia radiata*, Hyatt (**16**).
1889. *Carteriospongia radiata*, Keller (**18**).
? 1889. *Phyllospongia pennatula*, Lendenfeld (**20**).

This species is represented by several detached fronds, all collected together from one locality. The largest lamella measures 190 mm. wide, 130 mm. high, and is 5 mm. thick, and arises from a pair of short cylindrical stalks, each of which possesses a disc-like base. These twin stalks are 6 mm. in diameter and 11 mm. high.

The typical radiate appearance of the sponge surface around the oscula is very well shown in all the specimens.

Colour in spirit white.

Locality. Khor Dongonab.

Distribution. Red Sea, Indian Ocean, Australia.

EUSPONGIA ZIMOCCA (*O. Schmidt*).

Synonymy:—

1862. *Spongia zimocca*, O. Schmidt (**26**).
1879. *Euspongia zimocca*, Schulze (**26** *a*).
1889. *Euspongia zimocca*, Lendenfeld (**20**).

There are two specimens of this sponge in the collection—one a mere fragment; the other a complete subspherical cushion measuring 15 mm. in length, 12 mm. in width, and 10 mm. in height from base to summit.

Localities. Suez mud-flats; Khor Dongonab.

Distribution. Red Sea, Mediterranean.

EUSPONGIA OFFICINALIS, var. ARABICA (*Keller*).

Synonymy:—

1889. *Euspongia officinalis*, var. *arabica*, Keller (**18**).
1906. *Euspongia officinalis*, var. *arabica*, Topsent (**35**).

This variety of the bath-sponge is represented by three specimens, neither of which is large enough to be of value commercially. Each consists of an upright mass of somewhat irregular shape, from the summit or side of which one or more cone-like lobes arise. These lobes are approximately spherical

in section, and are tubular, each bearing an osculum at the summit; they vary in diameter from 8 mm. to 35 mm.

The surface of the sponge is minutely and regularly conulose, the conuli varying in height from 0·1 mm. to 0·5 mm.; they are on the average about 1·0 mm. apart.

The oscula are not confined to the cones referred to above, but occur sparsely scattered over the whole of the sponge-surface. There are four or five of these oscula on each specimen, and they measure about 3 mm. to 4 mm. in diameter.

The pores were very difficult to make out, but where seen they were numerous and scattered over the whole surface.

The colour of the sponge in spirit is very deep black on the outside and a dark brownish in the interior.

The texture is very soft and delicate, but also very firm.

Skeleton arrangement.

The main fibres run radially, and contain foreign bodies; they measure 0·08 mm. in diameter. The secondary fibres are not definitely oriented, but the reticulation is fairly regular and even. The diameter of these secondary fibres does not exceed 0·02 mm. The diameter of the mesh is about 0·1 mm.

The canal-system needs no special description, there being no points in which the present specimens differ from the descriptions previously given of this variety.

Locality. Suakin Harbour.
Distribution. Red Sea.

EUSPONGIA OFFICINALIS, var. CEYLONENSIS.

Synonymy:—
Euspongia officinalis, var. *ceylonensis*, Dendy (**11**).

This sponge is represented in the collection by a fairly large and extremely fine specimen. It consists of a subspherical cushion attached to the substratum by a broad base, and perfectly regular in shape. The surface is very finely conulose, and the conuli are very small and close together; they are mostly about 0·2 mm. high.

The oscula are large, but not numerous, and scattered regularly over the surface. They measure 3 mm. to 5 mm. in diameter.

The colour of the specimen is black in spirit.

The skeleton consists of a reticulation of spongin-fibre, in which primary and secondary fibres can be clearly differentiated. The main fibres measure, as a rule, 0·15 mm. in diameter, and are filled with extremely small sand-grains. They run strictly radially, and are very regularly distributed throughout the sponge, usually being separated at the sponge surface by about 0·8 mm.

The secondary fibres form a very close but not very regular meshwork, and measure 0·02 in diameter. No definite size of the mesh can be given, but 0·2 mm. is suggested as an approximate average.

This variety does not seem to be at all definitely distinguished from the New-World variety *rotunda* of the same species.

Locality. The specimen was obtained on the north-west of Condenser Island, Suakin Harbour.

Distribution of the variety. Red Sea; Ceylon; ? Florida.

The Sponge Fauna of the Red Sea.

The first complete account of the then-known Sponge Fauna of the Red Sea was published in 1889 and 1891 by Conrad Keller (**18**), when he described 88 species of sponges. Since then this list has been increased by four other reports on collections, one being by Schulze (**27**), describing 3 Hexactinellids, and the other three papers being all by Topsent (**31, 32, 35**). By these four publications the number of known species of sponges was increased to 108, and at the time when Mr. Crossland made the collection at present being described, this total had not been increased. Of the 93 species of sponges obtained by Mr. Crossland no less than 79 are new to the Red Sea, so that there is now a total of 187 species known to occur in this region.

The very large proportion of species new to the Red Sea in Mr. Crossland's collection is very probably explicable to a very large extent in the fact that the area in which he collected was one which had been left almost untouched previously. With the exception of the Gulf of Suez, the localities which had been investigated when Keller wrote his work on the subject were almost entirely confined to the southern portion of the Sea, and the most northerly point (save those in the Gulf of Suez) that he obtained sponges at was Suakin, almost all his specimens coming from either Suakin, Massaua, Asab Bay, or Beilul Bay. The collections investigated by Topsent came, one from the Red Sea proper (**32**), one from the Gulf of Tajoura (**31**), and one from the Gulf of Jibuti (**35**), both these last two places being just outside the Red Sea and in the Gulf of Aden.

They lie so very close to the Red Sea, however, and the sponge fauna, as evidenced by these collections, is so very closely related to that of the Red Sea, that I propose to include the Gulf of Aden with the Red Sea in these notes as one and the same area.

At the present time almost the whole of the African coast of the Red Sea has been carefully collected over, and the large number of species that have been obtained is, I think, evidence that the collecting has been very thorough; but we have practically no knowledge of the fauna of the Asian

side of the Sea, only one spot having been investigated, *i. e.* Jeddah, and only four species having been obtained there.

A table is appended (Table A) showing all the localities in the Red Sea where sponges have been collected; and another table (Table B) to show the distribution of the various species throughout the globe.

An examination of this second table will show that the Red Sea shows a very considerable affinity to the other parts of the Indian Ocean in its sponge fauna. The following 49 species are common to some part of the two regions:—*Clathrina primordialis, Clathrina canariensis* var. *compacta, Clathrina tenuipilosa, Clathrina darwinii, Sycon raphanus, Sycon coronatum, Leucandra primigenia, Leucandra microrhaphis, Leucandra pulvinar, Leucilla bathybia, Aulocystis zitteli, Tethya lyncurium, Tethya seychellensis, Tethya japonica, Tethya ingalli, Suberites carnosus, Terpios viridis, Placospongia melobesioides, Cliona celata, Cliona vastifica, Chondrilla nucula, Chondrosia reniformis, Grayella cyathophora, Tetilla poculifera, Cinachrya schulzei, Reniera implexa, Trachyopsis halichondrioides, Ceraochalina pergamentacea, Siphonochalina communis, Siphonochalina tubulosa, Siphonochalina intermedia, Gelliodes poculum, Clathria frondifera, Acanthella aurantiaca, Phakellia donnani, Ciocalypta tyleri, Psammopemma commune, Aplysina reticulata, Aplysina inflata, Aplysina purpurea, Cacospongia cavernosa, Hircinia variabilis, Hircinia fasciculata, Hircinia rugosa, Hircinia clathrata, Phyllospongia radiata, Phyllospongia otahitica, Phyllospongia madagascariensis, Euspongia officinalis.*

Of these, 17 are common to the Red Sea and the eastern coasts of Africa and the islands near, 25 to the Red Sea and Ceylon, and 30 to the Red Sea and Australia and the East Indies.

And even such a list of identical species does not exhaust the similarity between the two groups. Certain of the genera represented in the Red Sea by species confined to that locality, (as far as we know), are represented in other parts of the Indian Ocean by very closely allied species, such as *Paratetilla cineriformis* from Ceylon and *Paratetilla eccentrica* from the Red Sea. *Paratetilla*, moreover, and *Axinissa*, another genus represented in the Red Sea, though not in this collection, are widely distributed over the Indian Ocean, but do not occur outside it.

I therefore propose to enlarge the "Indo-Australian" region as defined by Ridley and Dendy (**24**), and enlarged by Dendy (**11**), to embrace the whole of the Indian Ocean, and the whole of the African shores from Suez to the Cape of Good Hope; and I propose to divide it into Eastern and Western divisions by a line following the 65th meridian of East longitude. To justify this division is at present rather difficult, as our knowledge of the sponge fauna of the East African region is much more scanty than our knowledge of the others, and elaborate comparisons of the two faunas are therefore impossible. It seems clear, however, from Dendy (**11**) that the

Ceylon fauna is extremely closely allied to the Australian, and though the list of species common to both Ceylon and the Red Sea has been increased since 1904 (when Professor Dendy's work was written) from 14 to 25, yet the gap is still clearly apparent when examining two collections from the different areas at the same time.

Of the relation of the Red Sea fauna to that of East Africa it is more difficult to speak. Very little indeed has been done since Ridley's report on the 'Alert' sponges (**23**), many of which came from this region. Certainly the number of species known has been increased since then, but even now the number does not approach that known from either the Red Sea or Ceylon. Keller, however, in 1891 (**18**) decided that the faunas of the Red Sea and East Africa were closely allied ; and Mr. Crossland, when writing an introduction to the series of reports of which this forms one, came to the same conclusion, though in the latter case the material on which the conclusion was based was not spongological but general.

The above opinion of the area and subdivisions of the Indo-Australian area has been expressed in Table B, and there both the eastern and western divisions have again been subdivided, in order to show as clearly as possible the distribution of the various species over the area. For the purposes of the subdivision Ceylon has been considered separate from the Australian region, and the Red Sea has been shown separately from the East African region. It must be noticed that the Australian region, as defined in this paper, exactly corresponds with the Indo-Australian area as defined by the 'Challenger' report.

Another group of sponges which occurs in the Red Sea also deserves attention. There are three species, long only known from the Mediterranean (in which they are common), which are now found also in the Red Sea. They are *Leucandra aspera, Placortis simplex*, and *Euspongia zimocca*. It is difficult to say anything definite as to the occurrence of these sponges in the Red Sea, but I think there is very great probability that they have come there by migration through the Suez Canal.

That such migration can, and actually does, take place, Keller (**18** *a*) gives ample proof, and I think the fact that all three of these species have been obtained at Suez is a strong support of the theory that they have migrated from the Mediterranean to the Red Sea.

TABLE A.

List of the Sponges of the Red Sea, with localities where the Species have been found.

	Suez Harbour.	Jebel Zeit.	Cape Elba.	Khor Abu Hamama.	Khor Shinab.	Khor Dongonab.	Suakin Harbour.	Shab-ul-Shubuk.	We Shubuk.	Sherm Sheikh.	Mersah Makdah.	Mersah Wadi Lehami.	Tella Tella Kebira.	Agig Harbour.	Massaua.	Dahlak Is.	"15° N. lat."	Beilul Bay.	Asab Bay.	Perim I.	Jeddah.	Masira I.	Aden Coasts.	Gulf of Tajoura.	Gulf of Jibuti.	Deeper parts of Red Sea.	Indefinite locality.
CALCAREA.																											
HOMOCŒLA.																											
Fam. CLATHRINIDÆ.																											
Clathrina coriacea (Montagu)	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
Clathrina primordialis (Haeckel)	...	...	...	...	...	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Clathrina canariensis (Miklucho-Macklay) var. *compacta* (Schuffner).	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Clathrina tenuipilosa, Dendy	×	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
Clathrina darwinii (Haeckel)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
HETEROCŒLA.																											
Fam. SYCETTIDÆ, Dendy.																											
Sycon raphanus, O. Schmidt	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Sycon coronatum (Ellis & Solander)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. GRANTIDÆ, Dendy.																											
Leucandra aspersa (O. Schmidt)	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leucandra primigenia (Haeckel)	×	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	×
Leucandra microrhaphis (Haeckel)	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leucandra (*Leucortis*) *pulvinar* (Haeckel)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. GRANTILLIDÆ, Row.																											
Grantilla hastifera, Row	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Grantilla quadriradiata, Row	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Fam. HETEROPIDÆ.																											
Grantessa glabra, Row	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Grantessa stauridea (Haeckel)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...	...	...	...	...
Fam. AMPHORISCIDÆ.																											
Leucilla bathybia (Haeckel)	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Leucilla intermedia, Row	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leucilla crosslandi, Row	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fam. PHARETRONIDÆ.																											
Kebira uteoides, Row	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
NON-CALCAREA.																											
MYXOSPONGIDA.																											
Fam. HALISARCIDÆ.																											
Halisarca dujardinii, Johnston	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fam. OSCARELLIDÆ.																											
Oscarella cruenta, Carter	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
TRIAXONIDA.																											
Fam. MÆANDROSPONGIDÆ.																											
Aulocystis grayi (Bowerbank)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
Aulocystis zitteli (Marshall & Mayer)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
Tretocalyx polæ, Schulze	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...
TETRAXONIDA.																											
Homosclerophora.																											
Fam. PLAKINIDÆ.																											
Placortis simplex, Schulze	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Astrotetraxonida.																											
Fam. PACHASTRELLIDÆ.																											
Pachastrella exostotica, O. Schmidt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...

TABLE A (*con.*).

	Suez Harbour.	Jebel Zeit.	Cape Elba.	Khor Abu Hamama.	Khor Shinab.	Khor Dongonab.	Suakin Harbour.	Shak-ul-Shubuk.	We Shubuk.	Sherm Sheikh.	Mersah Makdah.	Mersah Wadi Lehami.	Tella Tella Kebira.	Agig Harbour.	Massaua.	Dahlak Is.	"15° N. lat."	Beilul Bay.	Asab Bay.	Perim I.	Jeddah.	Masira I.	Aden Coasts.	Gulf of Tajoura.	Gulf of Jibuti.	Deeper parts of Red Sea.	Indefinite locality.
TETRAXONIDA (*con.*).																											
Fam. STELLETTIDÆ.																											
Pilochrota parva, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Stelletta siemensi, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. GEODIIDÆ.																											
Cydonium arabicum, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...
Geodia micropunctata, n. sp.	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Isops jousseaumi, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Fam. EPIPOLASIDÆ.																											
Coppatias albescens, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Diastra sterrastræa, n. gen. et sp.	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fam. TETHYIDÆ.																											
Tethya lyncurium, L.	×	...	...	...	...	×	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tethya seychellensis, Wright	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tethya (Donatia) japonica, Sollas	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Tethya (Donatia) ingalli (Bowerbank)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Tethya (Donatia) arabica, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Fam. SUBERITIDÆ.																											
Suberites carnosus, Johnston	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Suberites clavatus, Keller	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Suberites mastoideus, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Suberites incrustans, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Pseudosuberites hyalina (Ridley & Dendy)	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Axosuberites fauroti, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Terpios viridis, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Terpios lendenfeldi, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...

Fam. SPIRASTRELLIDÆ.																											
Spirastrella punctulata, Ridley	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Spirastrella decumbens, Ridley	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spirastrella vagabunda, Ridley, var. *arabica*, Topsent.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Placospongia melobesioides, Gray	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×
Latrunculia corticata, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×
Latrunculia magnifica, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fam. CLIONIDÆ.																											
Cliona celata, Grant	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cliona viridis (O. Schmidt) Gray	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Cliona vastifica (Hancock)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Sapline mussæ, Keller	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Fam. CHONDROSIIDÆ.																											
Chondrilla nucula, O. Schmidt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Chondrilla mixta, F. E. Schulze	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Chondrilla globulifera, Keller	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chondrosia reniformis, Nardo	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	×	...	...
Grayella cyathophora, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
SIGMATOTETRAXONIDA.																											
Fam. TETILLIDÆ.																											
Tetilla dactyloidea, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Tetilla arabica, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...
Tetilla poculifera, Dendy	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Paratetilla eccentrica, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chrotella ibis, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cinachrya schulzei, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×	...	...
Cinachrya eurystoma, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Cinachrya trochiformis, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. HAPLOSCLERIDÆ.																											
Subfam. RENIERINÆ.																											
Reniera implexa, O. Schmidt	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Reniera scyphonoides, Lamarck	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Reniera coccinea, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Reniera elastica, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Reniera ridleyi, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Reniera spinosella, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Reniera tabernacula, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
Reniera decidua, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...

TABLE A (*con.*).

	Suez Harbour.	Jebel Zeit.	Cape Elba.	Khor Abu Hamama.	Khor Shinab.	Khor Dongonab.	Suakin Harbour.	Shab-ul-Shubuk.	We Shubuk.	Sherm Sheikh.	Mersah Makdah.	Mersah Wadi Lehami.	Tella Tella Kebira.	Agig Harbour.	Mussaua.	Dahlak Is.	"15° N. lat."	Beilul Bay.	Asab Bay.	Perim I.	Jeddah.	Masira I.	Aden Coasts.	Gulf of Tajoura.	Gulf of Jibuti.	Deeper parts of Red Sea.	Indefinite locality.
SIGMATOTETRAXONIDA (*con.*).																											
Fam. HAPLOSCERIDÆ (*con.*).																											
Subfam. RENIERINÆ (*con.*).																											
Reniera ramusculoides, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Reniera depressa, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Halichondria granulata, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Halichondria tuberculata, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Halichondria glabrata, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Halichondria minuta, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...
Halichondria bubastes, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Halichondria (Amorphina) isthmica, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Damiria simplex, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...
Trachyopsis halichondrioides, Dendy	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Subfam. CHALININÆ.																											
Pachychalina furcata	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Pachychalina variabilis, Dendy	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Pachychalina alveolopora, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Chalina minor, n. sp.	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina densa, Keller	×	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	×
Ceraochalina gibbosa, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina ochreacea, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina pergamentacea, Ridley	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...
Ceraochalina granulata, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Ceraochalina implexa, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Siphonochalina communis (Carter)	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Siphonochalina tubulosa, Ridley	×	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×
Siphonochalina (Phylosiphonia) conica, Keller	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	×	...	×	...	...	...	...	...	×
Siphonochalina (Phylosiphonia) intermedia, Lendenfeld	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	×

Siphonochalina (Phylosiphonia) clavata, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	×	...	...	...	×	...	...	...	...	...	×
Siphonochalina (Phylosiphonia) vasseli, Keller	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spinosella sororia (Duch. et Mich.)	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spinosella incrustans, n. sp.	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spinosella (Siphonochalina) reticulata, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
Dactylochalina arenosa, Lendenfeld	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
Dactylochalina viridis, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sclerochalina fistularis, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Sclerochalina crassa, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	×
Sclerochalina sinuosa, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Arenochalina arabica, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Cacochalina calyx, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cacochalina maculata, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Antherochalina quercifolia, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Lessepsia violacea, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Subfam. GELLIINÆ																											
Gelliodes poculum, Ridley & Dendy	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gelliodes setosa, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...
Subfam. HETEROXYINÆ.																											
Anacanthæa nivea, n. gen. et sp.	...	...	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. DESMACIDONIDÆ.																											
Subfam. ESPERELLINÆ.																											
Esperella dendyi, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Esperella euplectellioides, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Esperella fistulifera, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Esperella suezza, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Esperella erythræana, n. sp.	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Leptosia lancifera, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Subfam. ECTYONINÆ.																											
Myxilla (Lissodendoryx) isodictyalis (Carter)	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Myxilla cratera, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Myxilla tenuissima, n. sp.	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Acarnus wolfgangi, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Echinodictium jousseaumei, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Echinodictium flabellatum, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Ophlitaspongia arbuscula, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ophlitaspongia horrida, n. sp.	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ophlitaspongia digitiformis, n. sp.	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Clathria frondifera (Bowerbank)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Subfam. TEDANIINÆ.																											
Tedania assabensis, Keller	×	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Trachytedania arborea, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×

TABLE A (*con.*).

	Suez Harbour.	Jebel Zeit.	Cape Elba.	Khor Abu Hamama.	Khor Shinab.	Khor Dongonab.	Suakin Harbour.	Shab-ul-Shubuk.	We Shubuk.	Sherm Sheikh.	Mersah Makdah.	Mersah Wadi Lehami.	Tella Tella Kebira.	Agig Harbour.	Massaua.	Dahlak Is.	"15° N. lat."	Beilul Bay.	Asab Bay.	Perim I.	Jeddah.	Masira I.	Aden Coasts.	Gulf of Tajoura.	Gulf of Jibuti.	Deeper parts of Red Sea.	Indefinite locality.
SIGMATOTETRAXONIDA (*con.*).																											
Fam. AXINELLIDÆ.																											
Hymeniacidon calcifera, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hymeniacidon zosteræ, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Acanthella aurantiaca, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	×
Acanthella flabelliformis, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Acanthella ehrenbergi, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Axinella pumila, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Axinissa gravieri, Topsent	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Phakellia donnani (Bowerbank)	...	...	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Phakellia palmata, n. sp.	...	...	?	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Ciocalypta tyleri, Bowerbank	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lithistida—Hoplophora.																											
Fam. TETRACLADIDÆ.																											
Discodermia stylifera, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...
EUCERATOSA.																											
Fam. APLYSILLIDÆ.																											
Aplysilla lacunosa, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Megalopastas erectus, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Darwinella aurea, Müller	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Fam. SPONGELIIDÆ.																											
Spongelia fragilis, var. *ramosa*, F. E. Schulze	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...
Spongelia herbacea, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Spongelia delicatula, n. sp.	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spongelia ædificanda, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Psammopemma commune (Carter)	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dysidea cinerea, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Dysidea nigra, Keller	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Euryspongia lactea, n. gen. et sp.	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Fam. SPONGIIDÆ.																											
Heteronema erecta, Keller	...	...	...	...	...	...	×	...	...	×	...	...	...	...	×	...	...	...	...	...	×	...	...	...	×	...	×
Duriella nigra, n. gen. et sp.	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aplysina reticulata, Lendenfeld	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aplysina inflata, Carter	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aplysina prætensa, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
Aplysina purpurea, Carter	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aplysina mollis, n. sp.	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...
(*Psammaplysilla arabica*, Keller)	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×
Cacospongia cavernosa, O. Schmidt	...	...	...	...	...	×	×	...	...	...	...	...	...	...	×	...	...	...	?	...	...	...	...	...	...	...	×
Halme robusta, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia variabilis, var. *typica*, O. Schmidt	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia variabilis, var. *hirsuta*, O. Schmidt	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia fasciculata, Esper	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia ramosa, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	×
Hircinia rugosa, Lendenfeld	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia atrovirens, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hircinia echinata, Keller	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Hircinia clathrata, Carter	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×
Phyllospongia madagascariensis, Hyatt	...	...	...	...	...	×	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *perforata*, Hyatt.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *radiata*, Hyatt.	...	...	...	...	...	×	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	×
Phyllospongia (*Carteriospongia*) *cordifolia*, Keller.	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Phyllospongia (*Carteriospongia*) *otahitica*, Hyatt.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...
Phyllospongia foliascens (Pall.) Lendenfeld	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	×	...	...
Euspongia zimocca (O. Schmidt)	×	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Euspongia officinalis, var. *arabica*, Keller	...	×	...	...	...	...	×	...	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	×	×	...	...
Euspongia officinalis, var. *ceylonensis*, Dendy	...	...	...	...	...	...	×	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

TABLE B.

Distribution of the Red Sea Species in other parts of the world.

	Indo-Australian. Western Division. Red Sea region.	Indo-Australian. Western Division. E. African region.	Indo-Australian. Eastern Division. Ceylon region.	Indo-Australian. Eastern Division. Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	Northern Atlantic. American Division.	Northern Atlantic. European Division. Atlantic coasts region.	Northern Atlantic. European Division. Mediterranean region.	Southern Atlantic.
CALCAREA.												
HOMOCŒLA.												
Fam. Clathrinidæ.												
Clathrina coriacea (Montagu) ...	×	...	...	...	...	...	...	...	×	×	...	...
Clathrina primordialis (Haeckel).	×	×	×	×	...	×	...	...	×	×	×	...
Clathrina canariensis (Miklucho-Maclay), var. *compacta* (Schuffner).	×	×	...	..	...	...	...	...	...	×	...	...
Clathrina tenuipilosa (Dendy) ...	×	...	×	...	...	...	...	...	...	...	...	...
Clathrina darwinii (Haeckel)......	×	×	×	...	...	...	...	...	...	...	...	...
HETEROCŒLA.												
Fam. Sycettidæ.												
Sycon raphanus, O. Schmidt	×	...	×	×	...	×	...	...	...	...	×	...
Sycon coronatum (Ellis & Sol.) ...	×	...	×	...	...	×	...	...	...	×	×	...
Fam. Grantidæ.												
Leucandra primigenia (Haeckel) .	×	×	...	×	...	...	...	...	×	×	×	...
Leucandra microrhaphis (Haeckel)	×	...	...	×	...	...	...	...	...	...	...	...
Leucandra aspera (O. Schmidt)...	×	...	...	...	...	...	...	...	...	×	×	...
Leucandra (*Leucotis*) *pulvinar* (Haeckel).	×	...	×	×	...	...	...	...	...	...	...	...
Fam. Grantillidæ.												
Grantilla hastifera, Row	×	...	...	...	...	...	...	...	...	...	...	...
Grantilla quadriradiata, Row ..	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Heteropidæ.												
Grantessa glabra, Row	×	...	...	...	...	...	...	...	...	...	...	...
Grantessa stauridea (Haeckel) ...	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Amphoriscidæ.												
Leucilla bathybia (Haeckel)	×	×	..	×	...	...	...	...	...	...	...	...
Leucilla intermedia, Row	×	...	...	...	...	...	...	...	...	...	...	...
Leucilla crosslandi, Row...........	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Pharetronidæ.												
Kebira uteoides, Row	×	...	...	...	...	...	...	...	...	...	...	...
NON-CALCAREA.												
MYXOSPONGIDA.												
Fam. Halisarcidæ.												
Halisarca dujardinii, Johnston ...	×	...	...	...	...	...	...	...	...	×	×	
Fam. Oscarellidæ.												
Oscarella cruenta, Carter	×	...	...	...	...	...	...	...	...	...	...	...

TABLE B (*con.*).

	Indo-Australian.								Northern Atlantic.			
	Western Division.		Eastern Division.							European Division.		
	Red Sea region.	E. African region.	Ceylon region.	Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	American Division.	Atlantic coasts region.	Mediterranean region.	Southern Atlantic.
TRIAXONIDA.												
Fam. Meandrospongidæ.												
Aulocystis grayi (Bowerbank) ...	×	...	...	...	...	...	...	...	×	...	...	...
Aulocystis zitteli (Marshall & Mayer).	×	...	...	×	...	×	...	...	×	...	...	...
Tretocalyx polæ, Schulze...........	×	...	...	...	...	...	...	...	...	...	...	...
TETRAXONIDA.												
Homosclerophora.												
Fam. Plakinidæ.												
Placortis simplex, Schulze	×	...	...	...	...	...	...	...	...	...	×	...
Astrotetraxonida.												
Fam. Pachastrellidæ.												
Pachastrella exostotica, O. Schmidt.	×	...	...	...	...	...	...	...	...	...	×	...
Fam. Stellettidæ.												
Pilochrota parva, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Stelletta siemensi, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Geodiidæ.												
Geodia micropunctata, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Cydonium arabicum (Carter)	×	...	...	...	...	...	...	...	...	...	...	...
Isops jousseaumi, Topsent	×	...	...	...	..	...	...	...	...	...	...	...
Fam. Epipolasidæ.												
Coppatias albescens, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Diastra sterrastræa, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Tethyidæ.												
Tethya lyncurium, Linnæus	×	...	×	...	...	...	...	...	×	×	×	...
Tethya seychellensis, Wright	×	×	?	×	...	...	...	...	×	...	...	×
Tethya (Donatia) japonica (Sollas)	×	...	...	×	...	...	...	...	...	...	...	...
Tethya (Donatia) ingalli (Bowerbank).	×	×	...	×	...	...	...	...	...	...	...	...
Tethya (Donatia) arabica, Carter .	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Suberitidæ.												
Suberites carnosus, Johnston	×	×	...	×	...	...	...	...	...	×	×	×
Suberites clavatus, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Suberites mastoideus, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Suberites incrustans, Keller	×	...	..	...	...	...	...	...	...	...	...	...
Pseudosuberites hyalinus (Ridley & Dendy).	×	...	...	...	...	...	...	×	...	...	×	...
Axosuberites fauroti, Topsent......	×	...	...	...	...	...	...	...	...	...	...	...
Terpios viridis, Keller..............	×	×	...	...	...	...	...	...	...	...	...	...
Terpios lendenfeldi, Keller.........	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Spirastrellidæ.												
Spirastrella punctulata, Ridley ...	×	...	...	...	...	...	...	...	...	...	...	...
Spirastrella decumbens, Ridley ...	×	...	...	...	...	...	...	...	...	...	...	...

TABLE B (*con.*).

	Indo-Australian.								Northern Atlantic.			
	Western Division.		Eastern Division.							European Division.		
	Red Sea region.	E. African region.	Ceylon region.	Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	American Division.	Atlantic coasts region.	Mediterranean region.	Southern Atlantic.
TETRAXONIDA (*con.*).												
Fam. Spirastrellidæ (*con.*).												
Spirastrella vagabunda, Ridley, var. *arabica*, Topsent.	×	...	...	...	...	...	...	...	...	...	...	...
Placospongia melobesioides, Gray	×	...	×	×	...	...	...	...	...	...	...	...
Latrunculia corticata, Carter	×	...	...	...	...	...	...	...	...	...	...	...
Latrunculia magnifica, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Clionidæ.												
Cliona celata, Grant	×	...	...	×	...	...	...	...	×	×	×	...
Cliona viridis (O. Schmidt), Gray.	×	...	...	...	...	...	...	...	×	...	×	..
Cliona vastifica, Hancock	×	...	×	×	...	×	...	...	×	×	×	...
Sapline mussæ, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Chondrosiidæ.												
Chondrilla nucula, Carter	×	×	×	×	...	...	...	...	×	×	×	×
Chondrilla mixta, F. E. Schulze	×	...	...	...	...	...	...	...	...	...	...	...
Chondrilla globulifera, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Chondrosia reniformis, Nardo	×	...	×	...	...	...	...	...	×	...	×	...
Grayella cyathophora, Carter	×	×	...	...	...	...	...	...	...	..	...	...
Sigmatotetraxonida.												
Fam. Tetillidæ.												
Tetilla dactyloidea, Carter	×	...	...	...	...	...	...	...	...	...	...	...
Tetilla arabica, Carter	×	...	...	...	...	...	...	...	...	...	...	...
Tetilla poculifera, Dendy	×	...	×	...	...	...	...	...	...	...	...	...
Paratetilla eccentrica, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Chrotella ibis, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Cinachrya schulzei, Keller	×	×	...	...	...	...	...	...	...	...	...	...
Cinachrya eurystoma, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Cinachrya trochiformis, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Haplosclcridæ.												
Subfam. Renierinæ.												
Reniera implexa, O. Schmidt	×	...	×	...	...	...	...	...	...	×	×	...
Reniera scyphonoides, Lamarck	×	...	...	?	...	...	...	...	...	...	...	...
Reniera coccinea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Reniera elastica, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Reniera ridleyi, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Reniera spinosella, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Reniera tabernacula, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Reniera decidua, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Reniera ramusculoides, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Reniera depressa, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Halichondria granulata, Keller	×	...	...	...	...	...	...	...	...	..	...	...
Halichondria tuberculata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Halichondria glabrata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Halichondria minuta, Keller	...	...	...	...	...	...	...	...	...	...	...	...
Halichondria bubastes, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...

TABLE B (*con.*).

	Indo-Australian. Western Division. Red Sea region.	Indo-Australian. Western Division. E. African region.	Indo-Australian. Eastern Division. Ceylon region.	Indo-Australian. Eastern Division. Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	Northern Atlantic. American Division.	Northern Atlantic. European Division. Atlantic coasts region.	Northern Atlantic. European Division. Mediterranean region.	Southern Atlantic.
TETRAXONIDA (*con.*).												
Fam. HAPLOSCLERIDÆ (*con.*).												
Subfam. RENIERINÆ (*con.*).												
Halichondria (Amorphina) isthmica, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Damiria simplex, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Trachyopsis halichondrioides, Dendy	×	...	×	...	...	...	...	...	...	...	...	...
Subfam. CHALININÆ.												
Pachychalina furcata	×	...	...	...	...	...	...	...	...	...	...	...
Pachychalina variabilis, Dendy	×	...	...	...	...	...	...	...	×	...	...	...
Pachychalina alveolopora, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Chalina minor, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina densa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina gibbosa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina ochreacea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina pergamentacea, Ridley	×	...	...	×	...	...	...	...	...	...	...	×
Ceraochalina granulata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Ceraochalina implexa, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Siphonochalina communis, Carter	×	...	×	×	...	...	...	...	...	...	...	...
Siphonochalina tubulosa, Ridley	×	×	...	×	...	...	...	...	...	...	...	...
Siphonochalina (Phylosiphonia) conica, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Siphonochalina (Phylosiphonia) intermedia, Lendenfeld.	×	...	...	×	...	...	...	...	...	...	...	...
Siphonochalina (Phylosiphonia) clavata, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Siphonochalina (Phylosiphonia) vasseli, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Spinosella sororia (Duch. et Mich.)	×	...	...	...	...	...	...	...	...	...	...	...
Spinosella incrustans, n. sp.	×	...	...	...	...	...	...	...	×	...	...	...
Spinosella (Siphonochalina) reticulata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Dactylochalina arenosa, Lfd.	×	...	...	...	...	...	...	...	...	...	...	...
Dactylochalina viridis, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Sclerochalina sinuosa, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Sclerochalina crassa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Sclerochalina fistularis, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Arenochalina arabica, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Cacochalina calyx, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Cacochalina maculata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Antherochalina quercifolia, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Lessepsia violacea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Subfam. GELLIINÆ.												
Gelliodes poculum, Ridley & Dendy	×	...	...	×	...	...	...	...	...	...	...	...
Gelliodes setosa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Subfam. HETEROXYINÆ.												
Anacanthæa nivea, n. g. et sp.	×	...	...	...	...	...	...	...	...	...	...	...

TABLE B (*con.*).

	Indo-Australian.								Northern Atlantic.			
	Western Division.		Eastern Division.							European Division.		
	Red Sea region.	E. African region.	Ceylon region.	Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	American Division.	Atlantic coasts region.	Mediterranean region.	Southern Atlantic.
TETRAXONIDA (*con.*).												
Fam. Desmacidonidæ.												
Subfam. Esperellinæ.												
Esperella dendyi, n. sp.	×	...	...	...	...	...	...	..	...	...	...	...
Esperella euplectellioides, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Esperella fistulifera, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Esperella suezza, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Esperella erythræana, n. sp.	×	...	...	...	...	..	...	...	...	...	...	...
Leptosia lancifera, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Subfam. Ectyoninæ.												
Myxilla (*Lissodendoryx*) *isodictyalis* (Carter).	×	...	...	...	...	...	...	...	×	...	...	...
Myxilla cratera, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Myxilla tenuissima, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Acarnus wolfgangi, Keller	×	...	...	...	...	..	...	...	...	...	...	...
Echinodictium flabellatum, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Echinodictium jousseaumei, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Ophlitaspongia arbuscula, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Ophlitaspongia horrida, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Ophlitaspongia digitiformis, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Clathria frondifera (Bbk.)	×	×	...	×	...	...	...	...	...	...	...	...
Subfam. Tedaniinæ.												
Tedania assabensis, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Trachytedania arborea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Axinellidæ.												
Hymeniacidon calcifera, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Hymeniacidon zosteræ, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Acanthella aurantiaca, Keller	×	...	×	...	...	...	...	...	...	...	...	...
Acanthella flabelliformis, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Acanthella ehrenbergi, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Axinella pumila, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Axinissa gravieri, Topsent	×	...	...	...	...	...	...	...	...	...	...	...
Phakellia donnani (Bowerbank)	×	...	×	...	...	...	...	...	...	...	...	...
Phakellia palmata, n. sp.	×	...	...	...	...	...	...	...	...	...	...	..
Ciocalypta tyleri, Bowerbank	×	...	×	...	...	...	...	...	...	...	...	...
Lithistida—Hoplophora.												
Fam. Tetracladidæ.												
Discodermia stylifera, Keller	×	...	...	...	...	...	...	...	...	...	...	...
EUCERATOSA.												
Fam. Aplysillidæ.												
Aplysilla lacunosa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Megalopastas erectus, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Darwinella aurea, Müller	×	...	...	...	...	...	...	...	...	×	×	×

TABLE B (*con.*).

	Indo-Australian.								Northern Atlantic			
	Western Division.		Eastern Division.							European Division.		
	Red Sea region.	E. African region.	Ceylon region.	Australian region.	Southern Ocean.	Northern Pacific.	Southern Pacific.	Patagonian.	American division.	Atlantic coasts region.	Mediterranean region.	Southern Atlantic.
EUCERATOSA (*con.*).												
Fam. Spongeliidæ.												
Spongelia fragilis, var. *ramosa*, F. E. Schulze.	×	...	...	...	...	...	...	...	...	...	...	...
Spongelia herbacea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Spongelia delicatula, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Spongelia ædificanda, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Psammopemma commune (Carter).	×	...	...	×	...	...	...	...	...	...	...	...
Dysidea cinerea, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Dysidea nigra, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Euryspongia lactea, n. g. et sp.	×	...	...	...	...	...	...	...	...	...	...	...
Fam. Spongiidæ.												
Heteronema erecta, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Duriella nigra, n. g. et sp.	×	...	...	...	...	...	...	...	...	...	...	...
Aplysina reticulata, Lendenfeld	×	...	×	...	...	...	...	...	...	...	...	...
Aplysina inflata, Carter	×	...	...	×	...	...	...	...	...	...	...	...
Aplysina prætensa, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
Aplysina purpurea, Carter	×	...	×	×	...	...	...	...	...	...	...	...
Aplysina mollis, n. sp.	×	...	...	...	...	...	...	...	...	...	...	...
(*Psammaplysilla arabica*, Keller)	×	...	...	...	...	...	...	...	...	...	...	...
Cacospongia cavernosa, O. Schmidt.	×	×	×	...	...	...	×	...	...	...	×	...
Halme robusta, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Hircinia variabilis, var. *typica*, O. Schmidt.	×	...	...	×	...	...	...	...	×	...	×	...
Hircinia variabilis, var. *hirsuta*, O. Schmidt.	×	...	×	×	...	...	...	...	...	...	×	...
Hircinia fasciculata, Esper	×	...	×	...	...	...	...	...	...	...	×	...
Hircinia ramosa, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Hircinia rugosa, Lendenfeld	×	...	...	×	...	...	...	...	...	...	...	...
Hircinia atrovirens, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Hercinia echinata, Keller	×	...	...	...	...	...	...	...	...	...	...	...
Hircinia clathrata, Carter	×	...	×	×	...	...	...	...	×	...	...	...
Phyllospongia madagascariensis, Hyatt.	×	×	...	...	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *radiata*, Hyatt.	×	...	×	×	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *cordifolia*, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *otahitica*, Hyatt.	×	...	...	×	...	...	...	...	...	...	...	...
Phyllospongia foliascens, Lendenf.	×	...	...	...	...	...	...	...	...	...	...	...
Phyllospongia (*Carteriospongia*) *perforata* (Hyatt).	×	...	...	×	...	...	...	...	...	...	...	...
Euspongia zimocca (O. Schmidt)	×	...	...	...	...	...	...	...	...	...	×	...
Euspongia officinalis, var. *arabica*, Keller.	×	...	...	...	...	...	...	...	...	...	...	...
Euspongia officinalis, var. *ceylonensis*, Dendy.	×	...	×	...	...	...	..	...	?	...	...	...

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EXPLANATION OF THE PLATES.

PLATE 35.

Fig. 1. *Paratetilla eccentrica.* × 5.
2. *Chrotella ibis.* × 2.
3. *Pilochrota parva.* × 4.
4. Portion of the surface of *Diastra sterrastræa.* × 7.
5. Portion of the under surface of *Geodia micropunctata*, showing oscula and Lamellibranch shell. × 4.

PLATE 36.

Fig. 6. *Pilochrota parva*, skeleton arrangement. × 20.
7. *Chrotella ibis*, skeleton arrangement. × 20.
8. *Paratetilla eccentrica*, skeleton arrangement. × 20.
9. *Coppatias albescens*, portion of surface. × 7.
10. *Halichondria bubastes.* × $1\frac{1}{2}$.
11. *Aplysina prætensa*, portion of specimen. × $1\frac{1}{2}$.

Plate 37.

Fig. 12. *Esperella euplectellioides*. $\times \frac{1}{2}$.
13. *Myxilla cratera*, portion of surface. $\times 5$.
14. *Ophlitaspongia* (?) *digitiformis*. $\times \frac{1}{3}$.
15. *Ophlitaspongia* (?) *digitiformis*, skeleton arrangement. $\times 20$.

Plate 38.

Fig. 16. *Phakellia donnani*. $\times 5$.
17. *Anacanthæa nivea*. $\times 1\frac{1}{2}$.
18. *Aplysina mollis*. $\times \frac{2}{3}$.
19. Portion of surface of *Hymeniacidon calcifera*. $\times 4$.

Plate 39.

Fig. 20. *Phakellia palmata*. $\times 1\frac{1}{2}$.
21. *Phakellia palmata*, skeleton arrangement. $\times 20$.
22. *Ophlitaspongia* (?) *arbuscula*. $\times \frac{1}{3}$.
23. Portion of surface of *Euryspongia lactea*. $\times 4$.

Plate 40.

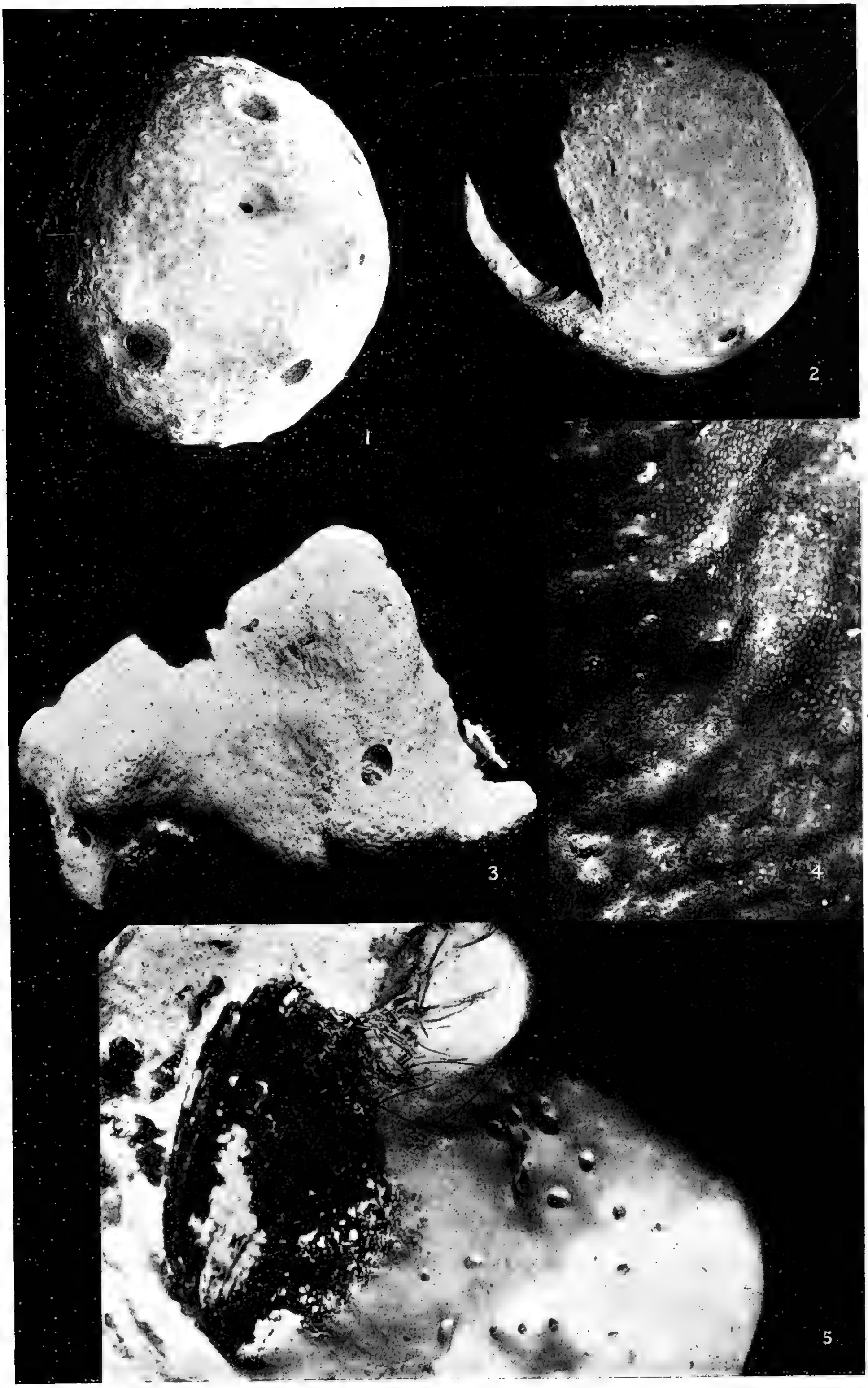
Fig. 24. *Geodia micropunctata*, skeleton arrangement. $\times 60$.
25. *Ophlitaspongia* (?) *arbuscula*, skeleton arrangement. $\times 60$.
26. *Ophlitaspongia* (?) *horrida*, skeleton arrangement. $\times 60$.

Plate 41.

Fig. 27. *Euryspongia lactea*, skeleton. $\times 40$.
28. *Euryspongia lactea*, canal-system. $\times 200$.
29. *Duriella nigra*, skeleton and canal-system. $\times 40$.

Lettering on Plates 40 & 41.

ch., chone.
cort. sk., skeleton of the cortex.
ex. c., exhalant canal.
fl. c., flagellated chambers.
inh. c., inhalant canal.
mes. f., fibres of the mesoglœa.
pig., pigment-cells.
sk. f., skeletal fibres.



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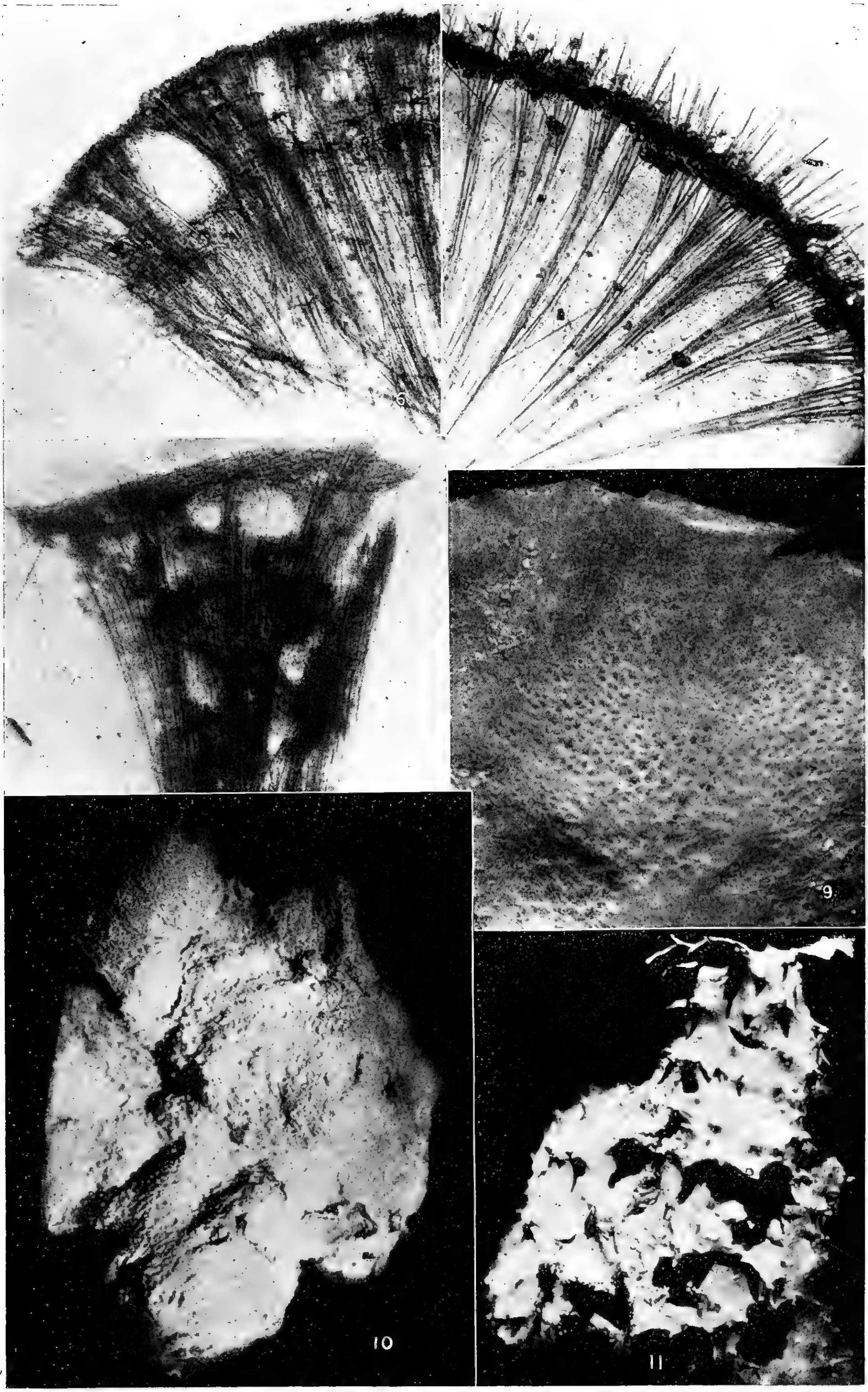

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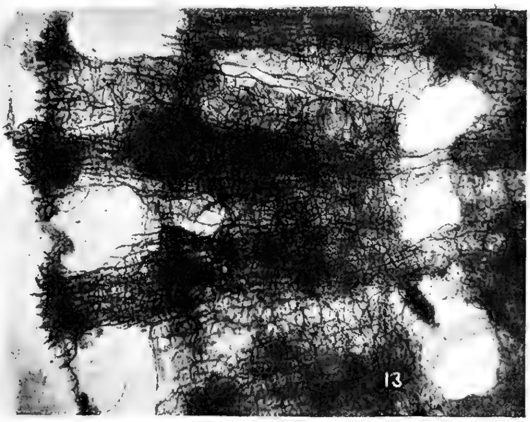

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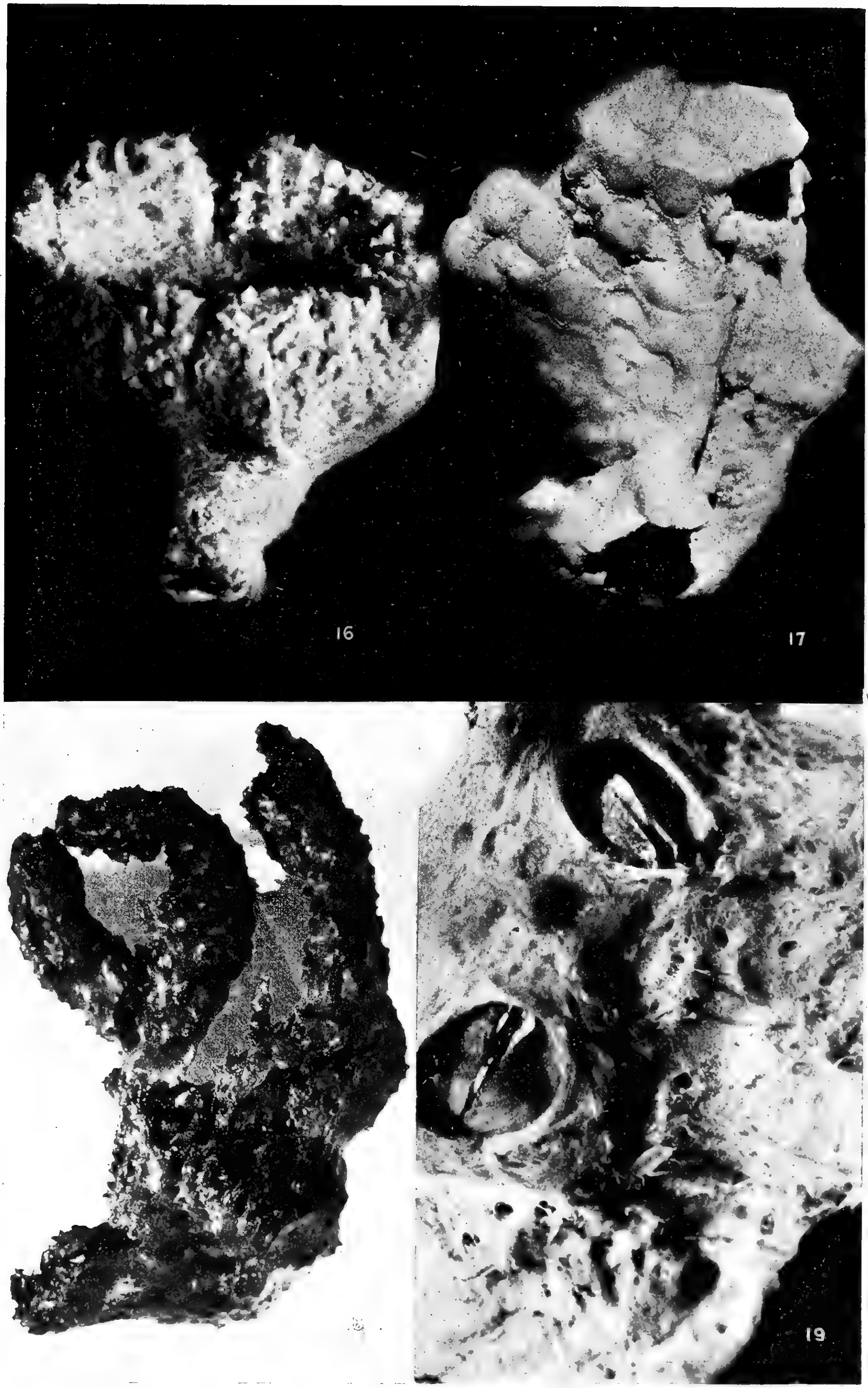

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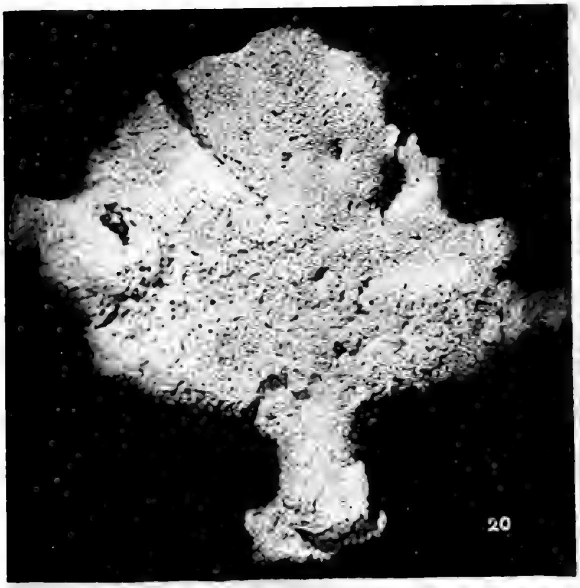

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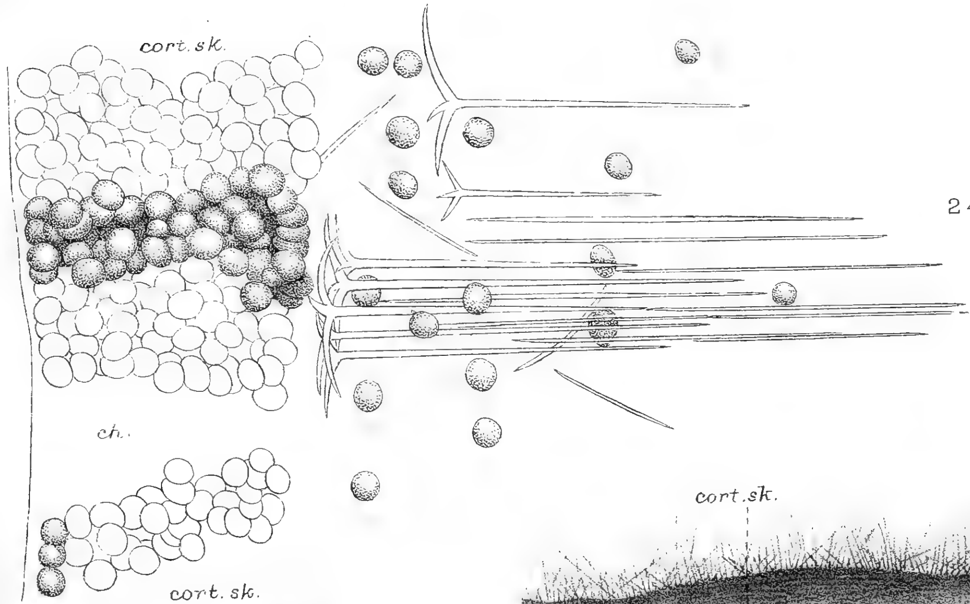

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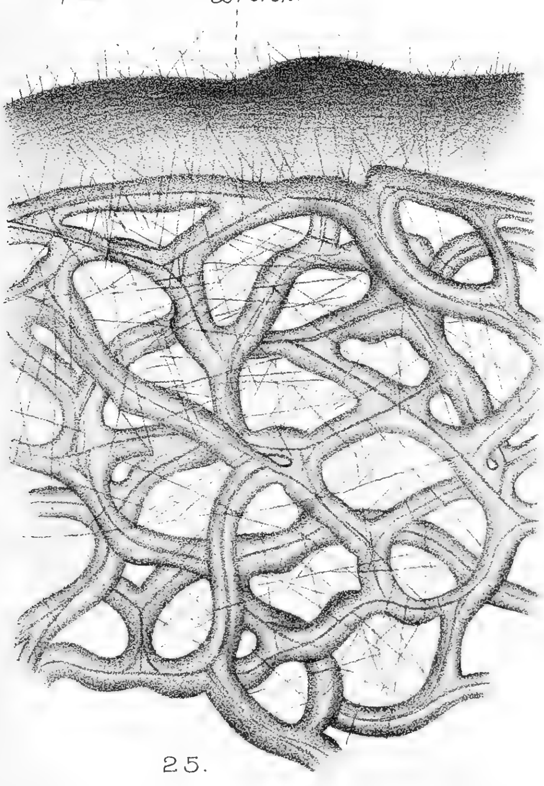

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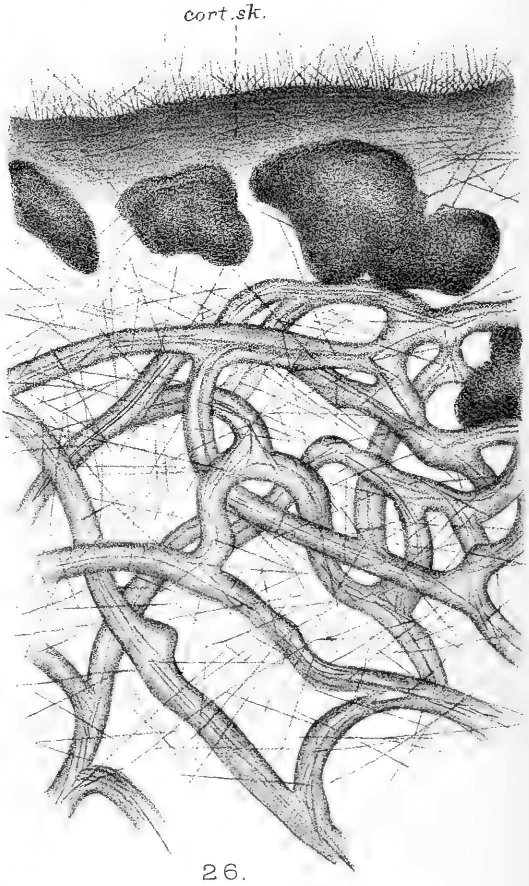

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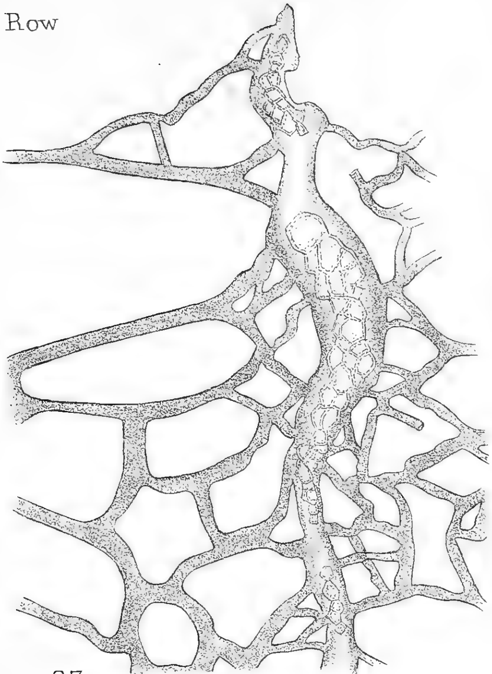

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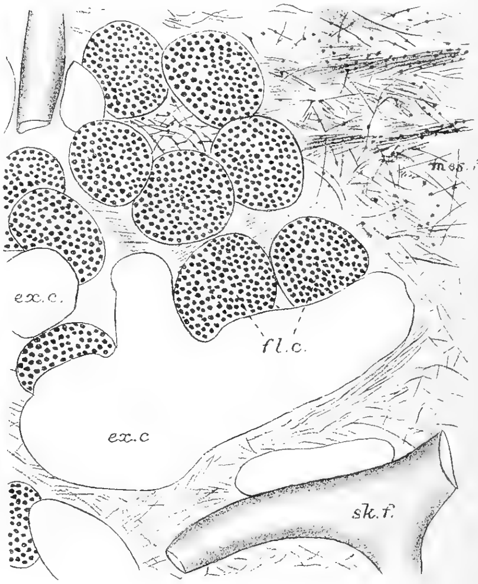

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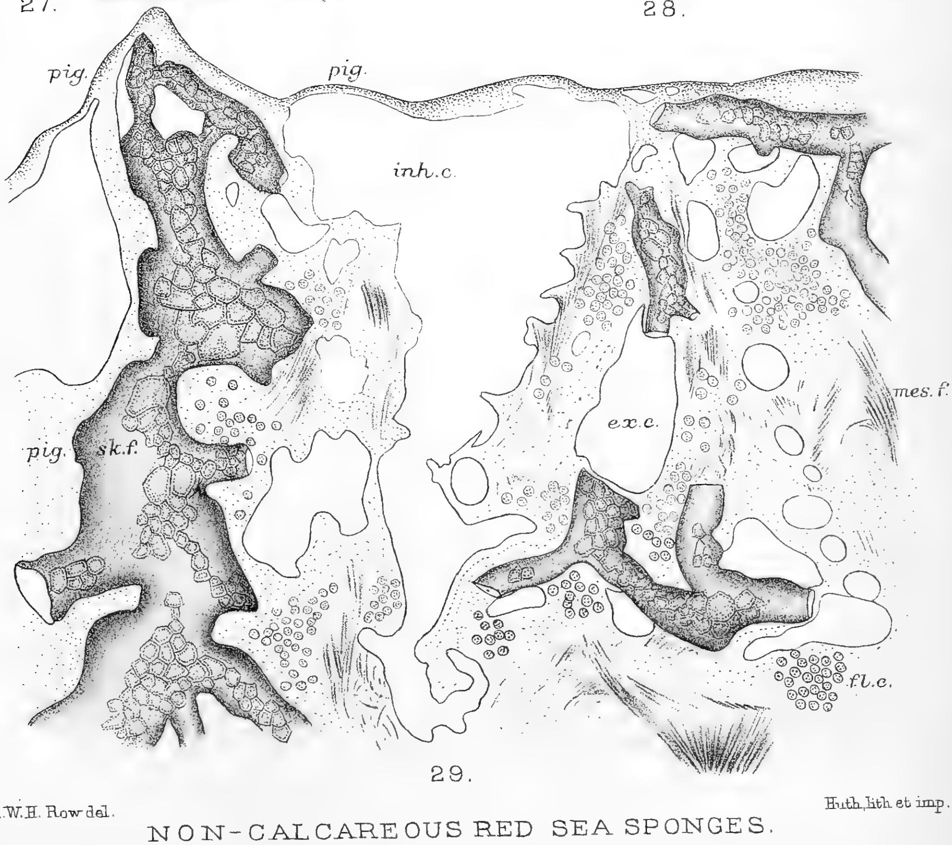

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REPORTS on the MARINE BIOLOGY of the SUDANESE RED SEA.—XX. ALGÆ (Supplement).

By R. J. HARVEY-GIBSON, M.A., F.L.S., Professor of Botany, and MARGERY KNIGHT, B.Sc., Assistant-Lecturer in Botany, University of Liverpool.

(With 4 Text-figures.)

[Read 20th February, 1913.]

(Reprinted from Journ. Linn. Soc., Bot. xli. (1913) pp. 305-309.)

IN the present volume (vol. xxxi.) of the Society's Journal (Zoology), pp. 76–80 (1908), and reprinted in Vol. xxxviii. (1909), Botany, pp. 441–445, a brief account was given by one of us (R. J. H.-G.) of a small collection of Marine Algæ made by Mr. C. Crossland in the years 1904 and 1905, while making investigations on the Marine Fauna of the Sudanese Coast. That collection included 35 species equally divided between Chlorophyceæ, Phæophyceæ, and Rhodophyceæ. In 1910, Mr. Crossland forwarded another small collection of Marine Algæ from the same region (chiefly from Khor Dongonab), but pressure of other work has prevented any detailed examination of the material until the present year (1912). This second collection includes 48 species (apart from varieties and forms), 36 of which are additions to the previous list. Four of these 36 are Cyanophyceæ, 10 are Chlorophyceæ, 8 are Phæophyceæ, and 14 are Rhodophyceæ.

The chief memoirs consulted have already been recorded in the paper above mentioned, and need not be repeated here; but we have had occasion to refer also to two important monographs by Mr. A. Gepp and Mrs. E. S. Gepp, viz.:—"Marine Algæ (Chlorophyceæ and Phæophyceæ)," and "Marine Phanerogams of the 'Sealark' Expedition," Trans. Linn. Soc. ser. 2 (Bot.), vol. vii. pt. 10; and "The Codiaceæ of the Siboga Expedition," Mono. lxii.

We have also to express our thanks to Mr. Gepp for kindly identifying one of the Phæophyceæ which we had difficulty in determining.

(Species not present in the previous collection are indicated by an asterisk.)

CYANOPHYCEÆ.

*1. SPHÆROZYGA CARMICHAELI, *Harv.*

*2. LYNGBYA SEMIPLENA (*Ag.*), *J. Ag.*

*3. CALOTHRIX PARASITICA (*Chauv.*), *Thur.*

*4. DERMOCARPA PRASINA (*Reinsch*), *Born.*

CHLOROPHYCEÆ.

*5. Halimeda Tuna, *Lamour.*, f. typica, *Bart.*

*6. Halimeda Opuntia, *Lamour.*, f. typica, *Bart.*
„ „ „ f. triloba, *Bart.*
* „ „ „ f. cordata, *Bart.*

7. Codium tomentosum, *Kütz.*

*8. Codium tenue, *Kütz.*

9. Avrainvillea lacerata, *J. Ag.*, f. typica, *Bart.*
„ „ „ f. robustior, *Bart.*

*10. Caulerpa Freycinetii, *J. Ag.*, var. de Boryana, *Van Bosse.*

*11. Caulerpa cupressoides, *J. Ag.*, var. Lycopodium, *Van Bosse.*

*12. Caulerpa scalpelliformis, *R. Br.*

13. Caulerpa racemosa, *J. Ag.*, var. uvifera, *J. Ag.*

14. Udotea argentea, *Zan.*, f. typica, *Bart.*

*15. Flabellaria minima, *Gepp.*

*16. Bryopsis implexa, *De Not.*
„ „ „ var. elegans, *Hauck.*

*17. Chætomorpha Linum, *Kütz.*

*18. Valonia ægagropila, *J. Ag.*

19. Dictyosphæria favulosa, *Decne.*

PHÆOPHYCEÆ.

20. Sargassum subrepandum, *J. Ag.*

21. Sargassum dentifolium, *J. Ag.*

*22. Sargassum linifolium, *J. Ag.*

*23. Cystoseira amentacea, *Bory.*

*24. Turbinaria decurrens, *Bory.*

*25. Zanardinia collaris, *Crouan.*

26. Padina pavonia, *J. Ag.*

*27. Zonaria variegata, *Mart.*

28. Hydroclathrus cancellatus, *Bory.*

*29. Hydroclathrus sinuosus, *Zan.*

*30. Dictyota dichotoma, *J. Ag.*, var. implexa, *Hauck.*

*31. Sphacelaria cirrhosa, *J. Ag.*, var. minima, *Zan.*

RHODOPHYCEÆ.

32. Spyridia filamentosa, *J. Ag.* (With cystocarpia and antheridia.)

*33. Gelidium crinale, *Thur.*

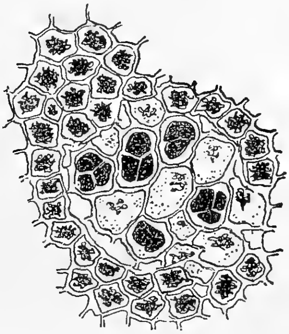
*34. Liagora viscida, *Ag.* (With cystocarpia and antheridia.)

*35. Digenea simplex, *Ag.*

*36. Galaxaura adriatica, *Zan.*

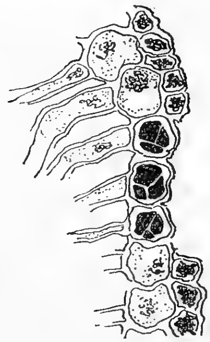
Hauck ('Die Meeresalgen Deutschlands und Œsterreichs') states that antheridia and tetragonidangia (tetrasporangia) are unknown in the genus. Only one plant of this species was present in the collection, but it was of special interest inasmuch that it bore both cystocarpia and tetragonidia. The gonidangia are developed on the terminal branches, and on surface view appear at the base of shallow depressions in the thallus. The main body of the thallus consists of loosely woven hyphæ passing over into shorter cells lying at right-angles to the surface. The exterior ends of these cells abut on a subepidermal layer of large cells, covered in turn by a compact external layer of rather smaller cells, which present a mosaic on surface view. The superficial cells

Fig. 1.



Surface view of the tetragonidial region. × 450.

Fig. 2.



Tetragonidial region in section. × 450.

are strongly calcified. The tetragonidia are formed in the subepidermal layer, and the mother-cell contents divide in the tetrahedral manner into the four tetragonidia. As the gonidangia mature the superficial cell-layer disappears, forming the shallow depression seen on surface view (figs. 1, 2). Cystocarpia are formed in the same branch and at the bottom of similar depressions.

While investigating the Marine Algæ of the Isle of Man, we have been struck with the frequency with which we have met with sexual and asexual organs, not merely on the same plant but on the same branch. This phenomenon we have observed in *Lophothalia byssoides*, *Callithamnion Hookeri*, *Callithamnion tetragonum*, *Callithamnion corymbosum*, and

Polysiphonia violacea. Indeed, we have been forced to the opinion that the joint occurrence of sexual and asexual cells on the same plant is by no means an exceptional phenomenon, and Mr. A. D. Cotton informs us that he has noticed the same joint occurrence in *Laurencia hybrida* and *Callithamnion* sp. In his paper on *Polysiphonia violacea* (Bot. Gaz. vol. xlii. 1906, p. 401), Yamanouchi demonstrates, in that species, a regular alternation of generation between a gametophyte with 20 chromosomes and a sporophyte with 40 chromosomes. At the same time, he records under the head of "Abnormalities," the occurrence of tetragonidia on cystocarpic or antheridial plants, and refers to similar cases noted by Lotsy in *Chylocladia kaliformis*, and by Davis in *Spermothamnion Turneri* and *Callithamnion Baileyi.* He adds, "Such cases should be carefully investigated to determine whether true tetraspores are present or whether the structures are not really of the nature of monospores, as in *Polysiphonia*, and developed with a suppression of reduction phenomena." In the plants of *Polysiphonia violacea* collected by us in 1912 at Port Erin, Isle of Man, cystocarpia and gonidangia were frequently present on the same branch, and the number of cases we met with, both in that species and in other genera, in our opinion, scarcely justifies the view that all of these are to be regarded as abnormalities. One of us is at present engaged on a detailed investigation of the matter from the cytological point of view, the results of which it is hoped to publish shortly. (See note, p. 405.)

*37. LOMENTARIA SQUARROSA, *Kütz.*

38. HYPNÆA VALENTIÆ, *J. Ag.* (With cystocarpia and tetragonidia.)

In this plant also we found both sexual and asexual reproductive organs in the same individual, indeed all the specimens were covered with "fruit" of both types. The cystocarpia are of the normal *Hypnæa* type. The tetragonidangia divide in a zonate manner and are formed abundantly from the superficial cells of ovoid pointed stichidia (fig. 3). The specimens were also interesting as exhibiting "Brutknospen," or vegetative buds, closely resembling those of *Sphacelaria.* The adult form of these buds is stellate (fig. 4 *a*, *b*, *c*, *d*), but all stages in their development could be readily traced on the same plant.

*39. LAURENCIA OBTUSA, *Lamour.* (With cystocarpia and antheridia.)

40. LAURENCIA PAPILLOSA, *Grev.* (With cystocarpia.)

*41. DUDRESNAYA COCCINEA, *Crouan.* (With cystocarpia and antheridia.)

*42. POLYSIPHONIA UTRICULARIS, *Zan.*

*43. MELOBESIA THURETII, *Born.* (On *Jania rubens*, with cystocarpia.)

*44. LITHOTHAMNION POLYMORPHUM, *Aresch.*

*45. LITHOTHAMNION FASCICULATUM, *Aresch.*

*46. Lithophyllum expansum, *Phil.*
*47. Lithophyllum crispatum, *Hauck.*
*48. Jania rubens, *Lamour.*

Fig. 4.

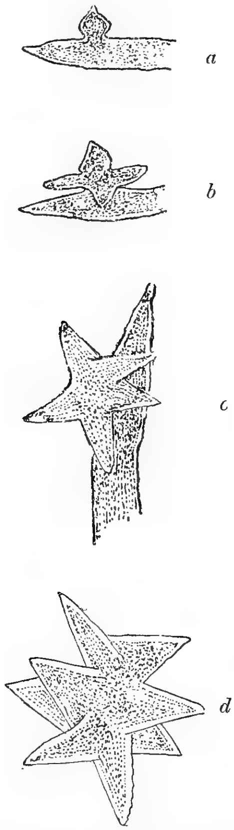
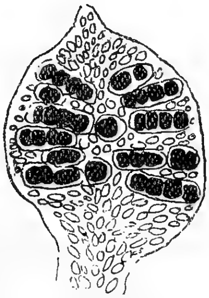


Fig. 3.



Longitudinal section of stichidium of *Hypnæa Valentiæ.*

Stages in the development of a vegetative bud of *Hypnæa Valentiæ.*

The collection also included fragments of Marine Phanerogams, more especially *Salicornia fruticosa*, Linn., *Cymodocea nodosa*, Asch., and *Halophila stipulacea*, Asch.

[Since writing the above paper we have noticed an article in the Bot. Gazette, Aug. 1912, by G. B. Rigg and A. D. Dalgity, in which similar phenomena are discussed in connection with another species of *Polysiphonia*, viz., *Polysiphonia bipinnata.* The authors indicate their intention of continuing the study of this plant from a cytological point of view. We still intend, however, to continue the research indicated above, as it may be of interest to compare the cytological conditions underlying this phenomenon in plants gathered from both western and eastern shores of the Atlantic.—R. J. H.-G. & M. K., 7th January, 1913.]

Reports on the Marine Biology of the Sudanese Red Sea.—XXI. On the Brachyura.

By R. Douglas Laurie, M.A. (Oxon.), Lecturer in Embryology and Senior Demonstrator in Zoology in the University of Liverpool. (Communicated by Prof. W. A. Herdman, F.R.S., F.L.S.)

(Plates **42–45** and 5 Text-figures.)

[Read 18th June, 1914.]

The collection comprises 65 species, of which 1, *Chlorodopsis arabica*, is new to science and 8 are new to the Red Sea. The latter are *Cryptodromia gilesii* (Alc.), *Notopus dorsipes* (Fabr.), two varieties of *Lambrus* (*Aulacolambrus*) *hoplonotus*, Ad. & Wh., *Chlorodopsis arabica,* Laurie, n. sp., *Actumnus setifer* (de Haan), var. *tomentosus*, Dana, *Litocheira integra* (Miers), *Macrophthalmus graeffei*, A. M.-Edw., and *Palicus whitei* (Miers). In addition, the very decided variety *cytherea* of *Chlorodiella niger* (Forsk.) is new to the Red Sea, and should perhaps be reinstated in the specific rank originally given to it by Dana.

Of the genera named above, 2 are new to the Red Sea fauna, namely, *Litocheira* and *Notopus*, and the latter is the first recorded Red Sea representative of the family Raninidæ.

The material in the collection helps in the elucidation of the following, in addition to other points of interest :—

Thalamita chaptalii and *T. poissonii*, both of Audouin and Savigny, 1826, are easily separable species.

Lambrus (*Aulacolambrus*) *hoplonotus*, Ad. & Wh., will, I think, be found to comprise at least two species.

Macrophthalmus inermis, A. M.-Edw., is, I believe, incorrectly considered by Alcock to be a synonym of *M. convexus*, Stm. See note under *M. graeffei*, A. M.-Edw.

Ophthalmias curvirostris (A. M.-Edw.) is, I believe, quite a good species, easily distinguishable from *O. cervicornis* (Herbst). In addition to a series of other points of difference, I call attention to the figures which I give of the external maxillipedes in the two forms. There is in my mind a doubt as to the correctness of the single record of *O. cervicornis* from the Red Sea.

My specimens confirm Nobili's suggestion that *Dotilla affinis,* Alc., 1900, is a synonym of *D. sulcata* (Forsk., 1775). I find that the supposed distinction was in part based upon a sex-difference.

Chlorodopsis wood-masoni, Alc., 1898, is a doubtful synonym of *C. spinipes* (Hell., 1861).

The possible identity of *Actæa polyacantha* (Hell., 1861) with *A. peronii* (H. M.-Edw., 1834) is a point requiring investigation.

A study of certain growth-changes has been made in the 40 specimens of the common species *Chlorodiella niger* (Forsk.), as also in *Trapezia cymodoce* (Herbst), and less fully in *Phymodius sculptus* (A. M.-Edw.) and some others.

Lupa alcocki (Nob., 1905), *Herbstia corniculata*, Klunz., 1906, and *Macrophthalmus graeffei*, A. M.-Edw., 1873, have hitherto been known only by their type-specimens, and of each of the two latter species the present collection contains the first recorded male example.

Caphyra monticellii, Nob., and *Lupa alcocki* (Nob.), are here figured for the first time.

Other interesting forms in the collection include *Nucia pulchella* (A. M.-Edw.), *Cyphocarcinus minutus*, A. M.-Edw., and *Thalamita* (*Thalamatoïdes*) *tridens*, var. *spinigera* (Nob.).

Workers on Red Sea Brachyura will find two publications indispensable as a starting-point, namely, Alcock's 'Materials for a Carcinological Fauna of India' and Nobili's 'Faune Carcinologique de la Mer Rouge.' Nobili records all species known from the Red Sea at the time of his writing in 1906. Klunzinger the same year published his 'Spitz- und Spitzmundkrabben des Roten Meeres,' seen by Nobili when the latter had completed the body of his work, and reviewed briefly by him in an appendix. Klunzinger gives some useful descriptions and translations of some of Paulson's Russian descriptions. He considers *Acanthonyx consobrinus* of Paulson as a synonym of *A. elongatus*, Miers, so that *A. consobrinus*, A. M.-Edw., is to be deleted from Nobili's enumeration, and he adds the following 7 species to the Red Sea fauna, namely, *Simocarcinus camelus*, Klunz., *Herbstia corniculata*, Klunz., *Herbstia contiguicornis*, Klunz., *Heterocrypta petrosa*, Klunz., *Parthenope acuta* Klunz., *Eumedonus convictor*, Bouv. et Seu., and *Hyastenus brockii*, de Man, of which the first five were new to science. Including the 8 species added by the present paper, the revised list in Table I. shows a total of 260 species recorded from the Red Sea.

The Red Sea Brachyuran fauna forms an integral part of the Brachyuran fauna of the Indo-Pacific region. To emphasize this, I have associated with the following complete list of Red Sea species a table showing to what extent they have been recorded in certain representative districts within the region. It will be noted from the headings of the columns that the records are exhaustive for some districts, while for others they refer to a single important collection from the district named.

TABLE I.

	Red Sea. Complete list, 1914.	Seychelles. Rathbun, **1911** (Gardiner's 'Sealark' collection). Miers, **1884** ('Alert' collection).	Persian Gulf. Nobili, **1907** (Bonnier et P. collection).	India. Alcock, 'Materials,' **1895–1900**. Complete list.	Maldives and Laccadives. Borradaile, **1901–1903** (3) (Gardiner's collection).	Ceylon. Laurie, **1906** (Herdman's collection).	Torres Straits. Calman, **1900** (Haddon's collection).	Hawaiian Islands. Rathbun, **1906**. Complete list.	West Africa. Rathbun, **1900**. Complete list.
Tribe **BRACHYURA.**									
Subtribe **Dromiacea.**									
Superfamily DROMIIDEA.									
Family DROMIIDÆ.									
Dromia dromia (Linn.) †	×	...	...	×	×	...	...	...	...
**Dromidia unidentata* (Rüpp.)	×	...	×	×	...	×	...	...	...
Cryptodromia canaliculata, Stimps.	×	×	...	?	...	×	...	...	...
—— *pentagonalis* (Hilg.)	×	×	...	?	...	...	...	...	...
*—— *hilgendorfi*, de Man	×	...	×	×	×	×	...	...	...
*—— *gilesii* (Alc.)	×	...	...	×	...	×	...	...	...
—— *granulata* (Kossm.)	×	...	...	...	...	...	...	...	...
Pseudodromia integrifrons, Hend.	×	...	...	×	...	...	...	...	...
Subtribe **Oxystomata.**									
Family CALAPPIDÆ.									
**Calappa hepatica* (Linn.)	×	×	...	×	×	...	×	×	...
—— *philargius* (Linn.)	×	...	...	×	...	×	...	...	...
—— *gallus* (Herbst)	×	×	...	×	×	×	...	×	×
Matuta banksii, Leach	×	...	...	×	×	...	...	...	...
—— *lunaris* (Forsk.) ‡	×	...	...	×	...	...	...	...	...
Family LEUCOSIIDÆ.									
Oreophorus horridus, Rüpp.	×	...	...	...	...	...	...	...	...
{ *Nursia jousseaumei*, Nob.	×	...	...	...	...	...	...	...	...
{ —— ——, var. *cornigera*, Nob.	×	...	...	...	...	...	...	...	...
—— *rubifera*, Müll.	×	...	...	×	...	...	...	...	...
Ebalia granulata (Rüpp.)	×	×	...	...	...	...	...	...	...
—— *abdominalis*, Nob.	×	...	...	...	...	...	...	...	...
—— *lacertosa*, Nob.	×	...	...	...	...	...	...	...	...
—— *orientalis*, Kossm.	×	...	...	...	...	...	...	...	...
Nucia tuberculosa, A. M.-Edw.	×	...	...	...	...	...	...	...	...
—— *pfefferi* (de Man)	×	...	...	×	...	...	...	...	...
*—— *pulchella* (A. M.-Edw.)	×	...	...	...	...	...	...	...	...
**Persephona fugax* (Fabr.)	×	×	...	×	...	×	×	...	...
—— *affinis* (Bell)	×	...	×	×	...	×	...	...	...
—— *kesslerii* (Pauls.)	×	...	...	...	...	...	...	...	...
**Leucosia signata*, Pauls.	×	...	...	...	...	...	...	...	...
—— *corallicola*, Alc.	×	...	...	×	...	...	...	...	...
—— *elata*, A. M.-Edw.	×	...	...	×	...	...	...	...	...
—— *hilaris*, Nob.	×	...	×	...	...	...	...	...	...

* Included in present collection.
† =*D. rumphii*, Fabr.; see Rathbun, **1902**, p. 32, and Ihle, **1913**, p. 22.
‡ =*M. victor* (Fabr.); see Stebbing, **1905** (**1**) p. 54.

TABLE I. (*con.*).

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Family LEUCOSIIDÆ (*con.*).									
Philyra scabriuscula (Fabr.)	×	...	...	×	...	...	...	...	...
—— *variegata* (Rüpp.)	×	...	...	...	...	...	...	...	...
—— *rectangularis*, Miers	×	×	...	...	...	...	...	...	...
Iphiculus spongiosus, Ad. & Wh.	×	...	...	×	...	...	...	...	...
Arcania septemspinosa (Fabr.)	×	...	...	×	...	...	...	...	...
Ixa inermis, Leach	×	...	...	?	...	...	...	...	...
Family DORIPPIDÆ.									
**Dorippe dorsipes* (Linn.)	×	×	×	×	×	×	...	...	...
Family RANINIDÆ.									
**Notopus dorsipes* (Fabr.)	×	...	...	×	...	...	...	...	...
Subtribe **Brachygnatha.**									
Superfamily OXYRHYNCHA.									
Family MAMAIIDÆ.									
**Camposcia retusa*, Latr.	×	...	...	×	...	×	...	...	...
**Acanthonyx elongatus*, Miers	×	...	...	...	...	...	...	...	...
Huenia proteus (de Haan)	×	×	...	×	×	×	×	×	...
{ *Simocarcinus simplex* (Dana)	×	×	...	×	...	...	...	×	...
{ —— ——, var. *pyramidatus* (Hell.)	×	...	...	×	...	×	...	...	...
—— *helleri* (Pauls.)	×	...	...	...	...	...	...	...	...
—— *camelus*, Klunz.	×	...	...	...	...	...	...	...	...
Menœthius monoceros (Latr.)	×	×	...	×	×	×	×	×	...
Hyastenus † *spinosus*, A. M.-Edw.	×	...	...	×	...	×	×	...	...
—— *tenuicornis*, Pocock	×	×	...	×	×	...	...	×	...
—— *brockii*, de Man	×	...	...	?	...	×	×	...	...
Perinea tumida, Dana ‡	×	...	...	...	...	...	...	×	...
Tylocarcinus styx (Herbst)	×	×	...	×	×	×	×	...	...
**Herbstia corniculata*, Klunz.	×	...	...	...	...	...	...	...	...
—— *contiguicornis*, Klunz.	×	...	...	...	...	...	...	...	...
Schizophrys aspera (H. M.-Edw.)	×	×	×	×	×	×	×	...	...
Cyclax suborbicularis (Stimps.)	×	×	...	×	×	×	×	...	...
**Stilbognathus erythræus*, v. Mart.	×	...	...	...	...	...	...	...	...
**Ophthalmias curvirostris* (A. M.-Edw.).	×	...	×	...	...	...	...	...	...
Pseudomicippa nodosa, Hell.	×	...	...	...	...	×	...	...	...
**Cyphocarcinus minutus*, A. M.-Edw.	×	×	×	×	...	...	...	...	...
{ *Micippa philyra* (Herbst)	×	...	...	×	×	×	×	×	...
{ —— ——, var. *mascarenica* Kossm.	...	...	×	...	...	...	...	...	...
{ —— *thalia* (Herbst)	×	...	...	×	...	×	...	...	...
{ —— ——, var. *haanii*, Stimps.	...	×	...	...	...	...	...	...	...

† No evidence that this genus=*Halimus*, Latr.; see Calman, **1913**, p. 313.
‡ =*Parathoë rotundata*, Miers; see Calman, **1909**, p. 713.

TABLE I. (*con.*).

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Family PARTHENOPIDÆ.									
**Parthenope horrida* (Linn.)	×	×	...	×	...	...	...	×	...
—— *acuta*, Klunz.	×	...	...	...	...	...	...	...	...
Lambrus (*Thyrolambrus*) *leprosus*, Nob.	×	...	...	...	...	...	...	...	...
—— (*Platylambrus*) *carinatus*, H. M.-Edw.	×	...	...	×	...	×	...	...	...
—— (*Aulacolambrus*) *pisoides*, Ad. & Wh.	×	...	...	...	...	...	...	...	...
*—— —— *hoplonotus*, Ad. & Wh.	×	×	...	×	...	×	×	×	...
*—— (*Rhinolambrus*) *pelagicus*, Rüpp.	×	...	...	×	×	×	...	...	...
—— —— *montiger*, Nob.	×	...	...	...	...	...	...	...	...
—— (*Pseudolambrus*) *calappoides* (Ad. & Wh.)	×	×	×	×	×	×	×	×	...
Heterocrypta petrosa, Klunz.	×	...	...	...	...	×	...	...	...
Eumedonus convictor, Bouv. et Seu.	×	..	...	...	...	...	...	...	...
Superfamily BRACHYRHYNCHA.									
Family PORTUNIDÆ.									
Carcinides † *mænas* (Linn.)	×	...	...	×	...	...	...	×	...
Portunus ‡ *subcorrugatus* (A. M.-Edw.)	×	...	...	...	×	×	×	×	...
Lissocarcinus orbicularis, Dana	×	×	...	×	...	...	...	...	...
**Caphyra monticellii*, Nob.	×	...	...	...	...	...	...	...	...
—— *polita* (Hell.)	×	...	...	...	...	...	...	×	...
Carupa læviuscula, Hell.	×	×	...	×	...	...	...	...	...
Scylla serrata (Forsk.)	×	...	...	×	...	×	×	...	...
Lupa pelagica (Linn.)	×	...	×	×	...	×	×	×	...
—— *sanguinolenta* (Herbst)	×	...	×	×	×	...	...	×	...
{ —— *longispinosa* (Dana)	×	×	...	×	...	×	...	...	...
{ —— ——, var. *bidens* (Lau.)	...	...	...	...	...	...	...	...	...
—— *arabica* (Nob.)	×	...	×	...	...	...	...	...	...
*—— *alcocki* (Nob.)	×	...	...	...	...	...	...	×	...
—— *granulata* (H. M.-Edw.)	×§	×	...	×§	×§	×‖	×§	...	...
—— *orbitosina* (Rath.)	...	×	...	...	...	×	...	...	...
—— *convexa* (de Haan)	×	...	...	×	...	...	...	×	...
**Charybdis erythrodactyla* (Lam.)	×	×	...	×	...	×	...	×	...
—— *orientalis* (Dana)	×	...	...	×	...	...	...	...	...
—— *hellerii* (A. M.-Edw.)	×	...	...	...	...	...	...	...	...
—— *merguiensis* (de Man)	×	...	...	×	...	...	...	...	...
—— *sexdentata* (Herbst)	×	...	...	×	...	...	...	...	...

† *Carcinides*, Rathbun, 1897 = *Carcinus*, Leach, 1814, *et auct.*; see Rathbun, **1897**, p. 164.

‡ Fabr., 1798. For nonadoption of *Liocarcinus*, Rath., see Steb. **1902**, p. 11, and **1908**, p. 11.

§ May be *L. orbitosina* (Rath., 1911); see Rathbun, **1911**, p. 205.

‖ I have re-examined an adult ♂ from off Mutwall Is. and 3 adult ♂ and 1 ♀ ovig. from Gulf of Manaar recorded as *granulata* and find that they come under *orbitosina*.

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Family PORTUNIDÆ (*con.*).									
Charybdis variegata (Fabr.)	×	...	...	×	...	...	...	...	...
—— *natator* (Herbst)	×	×	×	×	...	×	...	...	...
—— *heterodon*, Nob.	×	...	...	...	...	...	...	...	...
—— *anisodon*, de Haan	×	...	...	...	...	...	...	...	...
Archias sexdentatus, Pauls.	×	...	...	...	...	...	...	...	...
Thalamita prymna (Herbst). var. *typica*	×	×	...	×	...	...	×	...	...
—— ——, var. *annectans*, Lau.	...	...	...	...	...	×	...	...	...
—— ——, var. *crenata*, Latr.	×	×	×	×	...	×	...	...	...
—— ——, var. *danæ*, Stimps.	×	×	...	×	×	...	...	...	...
—— ——, var. *picta*, Stimps.	×	×	...	×	×	...	...	×	...
—— ——, var. *stimpsoni*, A. M.-Edw.	×	...	...	×	...	...	×	...	...
—— *chaptalii* (Aud. et Sav.)	×	...	...	×	...	×	...	...	...
*—— *poissonii* (Aud. et Sav.)	×	×	×	×	×	×	...	...	...
—— *sima*, H. M.-Edw.	×	×	...	×	×	...	×	×	...
—— *admete* (Herbst)	...	×	...	...	...	...	...	×	...
—— ——, var. *admete* (Herbst)	...	...	...	×	×	×	...	...	...
*—— ——, var. *savignyi*, A. M.-Edw.	×	...	×	×	×	...	×	...	...
*—— ——, var. *intermedia*, Borr.	×	...	...	...	×	...	...	...	...
—— ——, var. *granosimana*, Borr.	...	...	...	...	×	...	...	...	...
—— ——, var. *edwardsi*, Borr.	...	...	...	...	...	...	...	×	...
—— ——, var. *auauensis*, Rath.	...	...	...	...	...	...	...	×	...
—— ——, var. *margaritimana*, Rath.	...	×	...	...	...	...	...	...	...
—— ——, var. *quadrilobata*, Miers	...	×	...	×	...	...	...	...	...
*—— *integra*, Dana	×	×	...	×	...	×	...	×	...
—— ——, var. *africana*, Miers	...	...	...	...	...	...	...	...	×
—— *demani*, Nob.	×	...	...	...	...	...	...	...	...
—— *bandusia*, Nob.	×	...	...	...	...	...	...	...	...
—— (*Thalamitoïdes*) *quadridens*, A. M.-Edw.	×	...	...	...	...	...	...	...	...
*—— —— *tridens*, A. M.-Edw., var. *spinigera* (Nob.)	×	...	...	...	...	...	...	...	...
**Podophthalmus vigil* (Fabr.)	×	...	...	...	...	...	...	×	...
Family XANTHIDÆ.									
**Carpilius convexus* (Forsk.)	×	×	...	×	×	...	×	×	...
**Carpilodes lævis*, A. M.-Edw.	×	...	...	...	...	...	...	...	...
—— *ruber*, A. M.-Edw.	×	...	...	...	×	...	...	×	...
—— *diodoreus*, Nob.	×	...	...	...	...	...	...	...	...
*—— *rugatus* (H. M.-Edw.)	×	×	...	×	...	...	...	...	...
—— *vaillantianus*, A. M.-Edw.	×	×	...	×	×	...	...	×	...
—— *rugipes* (Hell.)	×	×	...	...	...	...	...	...	...
Liomera cinctimana (Wh.)	×	×	...	×	×	...	×	.	...
—— *pubescens* (H. M.-Edw.)	...	...	...	...	...	...	...	×	...
—— ——, var., Nob.	×	...	...	...	...	...	...	...	...

TABLE I. (*con.*).

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Family XANTHIDÆ (*con.*).									
Liomera themisto (de Man)	×	...	...	...	..	...	...	...	...
—— *granosimana*, A. M.-Edw.	×	×	...	...	...	...	...	...	...
Lioxantho punctatus (H. M.-Edw.)	×	...	...	×	×	...	...	...	...
—— *tumidus*, Alc.	×	...	...	×	×	...	...	...	...
—— *asperatus*, Alc.	×	...	×	×	×	...	..	...	...
**Atergatis roseus* (Rüpp.)	×	...	...	×	...	...	...	...	...
—— *ocyroë* (Herbst) †	×	...	...	×	×	...	×	...	...
—— *granulatus*, de Man	×	...	...	...	...	...	...	...	...
Platypodia cristata (A. M.-Edw.)	×	×	...	×	×	..	...	...	...
—— *granulosa* (Rüpp.)	×	...	...	×	×	...	×	×	...
—— *semigranosa* (Hell.)	×	×	...	×	×	...	...	×	...
*—— *anaglypta* (Hell.)	×	×	...	×	×	×	...	...	...
Atergatopsis frauenfeldi (Hell.)	×	...	...	...	...	...	...	...	...
—— *granulatus*, A. M.-Edw.	×	×	...	...	...	...	...	×	...
**Zosimus æneus* (Linn.)	×	×	...	×	×	...	...	...	...
Zozymodes carinipes, Hell.	×	...	...	...	...	...	...	...	...
Lophozozymus pulchellus, A. M.-Edw.	×	×	...	...	...	×	...	...	...
Euxanthus sculptilis, Dana	×	...	...	×	...	...	...	...	...
Hypocolpus diverticulatus (Strahl) ‡	×	×	...	...	...	..	...	...	...
**Xantho distinguendus*, de Haan	×	...	×	×	...	×	...	...	...
—— *hirtipes*, H. M.-Edw.	×	...	...	...	...	...	...	...	...
*—— *hydrophilus* (Herbst)	×	×	×	×	...	×	×	×	...
Leptodius gracilis (Dana)	×	×	...	...	...	...	...	×	...
—— *sanguineus* (H. M.-Edw.)	×	×	...	×	×	...	...	×	...
—— *euglyptus* (Alc.)	×	...	...	×	...	...	...	...	...
—— *cavipes* (Dana)	×	×	...	×	...	...	...	...	...
Cycloxanthops lineatus (A. M.-Edw.)	×	...	...	×	...	×	...	...	...
**Etisus lævimanus*, Rand.	×	×	×	×	×	...	×	×	...
Etisodes anaglyptus (H. M.-Edw.)	×	...	...	×	×	...	...	...	...
—— *electra* (Herbst)	×	×	×	×	×	...	×	×	...
Actæa (*Banareia*) *kraussi*, Hell.	×	...	...	...	...	...	...	...	...
—— *bella* (Dana)	×	...	...	...	...	...	...	...	...
*—— *tomentosa* (H. M.-Edw.)	×	×	...	×	×	...	...	×	...
*—— *hirsutissima* (Rüpp.)	×	×	...	×	...	...	...	×	...
—— *rufopunctata* (H. M.-Edw.)	×	×	...	×	×	...	...	×	...
*—— *garretti*, Rath.	×	×	...	...	...	...	...	×	...
—— *speciosa* (Dana)	×	×	...	×	×	×	...	×	...
—— *sabæa*, Nob.	×	...	...	...	...	...	...	...	...
—— *hellerii*, A. M.-Edw.	×	×	...	...	...	...	...	...	...
—— *nodulosa*, Wh.	×	×	...	×	...	...	...	×	...
*—— *polyacantha* (Hell.)	×	×	...	...	...	...	...	...	...
—— *pisigera*, Nob.	×	...	...	...	...	...	...	...	...

† = *Atergatis floridus* (Linn.); *fide* Rathbun, **1906**, p. 845.

‡ = *Cancer sculptus*, H. M.-Edw., 1834; *not* Herbst, 1794. *Fide* Rathbun, **1911**, p. 215.

TABLE I. (*con.*).

	Red Sea. Complete list, 1914.	Seychelles. Rathbun, **1911** (Gardiner's 'Sealark' collection). Miers, **1884** ('Alert' collection).	Persian Gulf. Nobili, **1907** (Bonnier et P. collection).	India. Alcock, 'Materials,' **1895–1900.** Complete list.	Maldives and Laccadives. Borradaile, **1901–1903** (**3**) (Gardiner's collection).	Ceylon. Laurie, **1906** (Herdman's collection).	Torres Straits. Calman, **1900** (Haddon's collection).	Hawaiian Islands. Rathbun, **1906**. Complete list.	West Africa. Rathbun, **1900**. Complete list.
Family XANTHIDÆ (*con.*).									
**Actæa granulata* (Aud. et Sav.)	×	×	×	×	×	×	...	...	...
—— ——, var. *carcharias* (Wh.)	...	...	...	...	...	...	×	...	...
—— *calculosa* (H. M.-Edw.)	×	...	...	×	...	×	×	...	...
*—— *fossulata* (Gir.)	×	...	×	×	×	...	...	...	...
**Chlorodiella niger* (Forsk.) †	×	×	×	×	×	×	×	×	...
*—— ——, var. *cytherea* (Dana)	×	...	...	...	...	...	...	...	...
—— *bidentatus* (Nob.)	×	...	...	...	...	...	...	...	...
—— *lippus* (Nob.)	×	...	...	...	...	...	...	...	...
**Phymodius ungulatus* (H. M.-Edw.)	×	×	×	×	×	...	×	×	...
*—— *sculptus* (A. M.-Edw.)	×	×	...	×	×	×	×	...	...
—— *granulatus* (Targ.-Tozz.)	×	...	...	...	...	...	...	...	...
Pilodius pugil, Dana	?	...	...	...	...	×	...	...	...
—— *armiger*, Nob.	×	...	...	...	...	...	...	...	...
—— *martensi* (Krauss)	×	...	...	...	...	...	...	...	...
Chlorodopsis areolata (H. M.-Edw.)	×	×	...	×	...	×	...	×	...
*—— *arabica*, Laurie	×	...	...	...	...	...	...	...	...
*—— *spinipes* (Hell.)	×	×	...	×	×	...	×	...	...
—— *frontalis* (Dana)‡	×	...	...	...	×	...	×	...	...
—— (*Cyclodius*) *ornata* (Dana)	×	...	...	×	?	...	...	...	...
**Cymo andreossyi* (Aud. et Sav.)	×	×	×	×	...	...	×	...	...
—— ——, var. *melanodactylus*, de Haan	×	×	×	×	×	×	×	...	...
—— *quadrilobatus*, Miers	×	×	...	×	×	...	...	...	...
Menippe rumphii (Fabr.)	×	...	...	×	...	...	...	...	...
Pseudozius caystrus (Ad. & Wh.)	×	×	...	×	×	...	...	×	...
—— *sinensis*, A. M.-Edw.	×	...	...	...	...	...	...	...	...
Ozius rugulosus, Stimps.	×	...	...	×	...	×	...	...	...
Epixanthus frontalis (H. M.-Edw.)	×	×	×	×	...	×	...	...	...
—— *corrosus*, A. M.-Edw.	×	×	...	...	...	...	...	...	...
Lydia § *tenax* (Rüpp.)	×	×	×	×	...	...	...	...	...
Heteropilumnus fimbriatus (H. M.-Edw.)	×	...	...	...	...	...	...	...	...
Pilumnus trichophoroides, de Man	...	×	...	...	...	...	...	...	...
—— ——, var.	×	...	×	...	...	...	...	...	...
—— *vespertilio* (Fabr.)	×	...	...	×	×	×	...	×	...
—— *forskålii*, H. M.-Edw.	×	...	...	...	...	...	...	...	...
—— *savignyi*, Hell.	×	...	×	...	...	...	...	...	...
*—— *propinquus*, Nob.	×	...	×	...	...	...	...	...	...
—— *hirsutus*, Stimps.	×	×	...	?	×	...	...	...	...
—— *quadridentatus*, de Man	×	...	...	...	...	...	...	...	...
—— *lævimanus*, Dana	×	...	...	...	...	...	...	...	...
—— *eudæmoneus*, Nob.	×	...	...	...	...	...	...	...	...
—— *spongiosus*, Nob.	×	...	...	...	...	...	...	...	...
—— *brachytrichus*, Kossm.	×	...	...	...	...	...	...	...	...
—— *schrenkii*, Pauls.	×	...	...	...	...	...	...	...	...
—— *asper* (Rüpp.)	×	...	...	...	...	...	...	...	...
Actumnus globulus, Hell.	×	×	...	...	...	...	...	...	...

† It is doubtful how far authors have distinguished in their records between *C. niger* and var. *cytherea*.
‡ = *Etisodes frontalis*, Dana; see Borradaile, **1902** (**2**), p. 261.
§ = *Eurüppellia*, Miers; see Rathbun, **1906**, p. 862.

TABLE I. (*con.*).

	Red Sea. Complete list, 1914.	Seychelles. Rathbun, **1911** (Gardiner's 'Sealark' [collection]. Miers, **1884** ('Alert' collection).	Persian Gulf. Nobili, **1907** (Bonnier et P. collection).	India. Alcock, 'Materials,' **1895–1900**. Complete list.	Maldives and Laccadives. Borradaile, **1901–1903** (3) (Gardiner's collection).	Ceylon. Laurie, **1906** (Herdman's collection).	Torres Straits. Calman, **1900** (Haddon's collection).	Hawaiian Islands. Rathbun, **1906**. Complete list.	West Africa. Rathbun, **1900**. Complete list.
Family XANTHIDÆ (*con.*).									
Actumnus setifer (de Haan)	...	...	...	...	...	...	×	...	...
—— ——, var.	...	×	...	...	...	...	...	...	...
—— ——, var. *setifer* (de Haan)	...	...	...	×	×	×	...	...	...
*—— ——, var. *tomentosus*, Dana	×	...	×	×	×	×	...	...	...
—— ——, var. *amirantensis*, Rath.	...	×	...	...	...	...	...	..	...
*—— *bonnieri*, Nob.	×	×	×	...	...	×	...	...	...
—— *obesus*, Dana	×	×	...	...	...	...	...	×	...
**Heteropanope vauquelini* (Aud. et Sav.).	×	...	...	...	...	...	...	...	...
—— *pharaonica*, Nob.	×	...	...	...	...	...	...	...	...
Eurycarcinus natalensis (Krauss)	×	...	...	...	...	...	...	...	...
—— *orientalis*, A. M.-Edw.	×	...	...	...	...	...	...	...	...
—— *integrifrons*, de Man	×	...	...	×	...	...	...	...	...
Eriphia sebana (Shaw) †	...	×	...	×	×	...	...	×	...
—— ——, var. *smithii*, Macl.	×	×	×	×	...	...	...	...	...
—— *scabricula*, Dana	×	×	...	×	×	...	...	...	...
**Trapezia cymodoce* (Herbst)	×	×	×	×	×	×	×	×	...
—— ——, var. *ferruginea*, Latr.	×	×	×	×	×	...	...	×	...
—— ——, var. *areolata*, Dana	...	...	...	×	...	×	×	...	...
—— ——, var. *guttata*, Rüpp.	×	...	...	×	×	...	...	...	...
*—— ——, var. *maculata* (Macl.)	×	×	...	×	×	×	...	×	...
—— *digitalis* (Latr.)	×	×	...	×	×	...	...	×	...
**Tetralia glaberrima* (Herbst)	×	×	×	×	×	×	×	...	...
Quadrella coronata, Dana	...	×	...	×	...	...	...	...	...
—— ——, var.	×	...	×	...	...	...	...	...	...
—— ——, var. *granulosa*, Borr.	...	...	...	...	×	×	...	...	...
—— ——, var. *maculosa*, Alc.	...	×	...	×	...	...	...	...	...
Lybia denticulata, Nob.	×	...	...	...	...	...	...	...	...
Family GONEPLACIDÆ.									
Eucrate crenata, de Haan	×	×	×	×	...	...	...	...	...
—— ——, var. *dentata* (Stimps.), Alc.	×	...	...	×	...	...	...	...	...
**Libystes nitidus*, A. M.-Edw.	×	...	...	...	...	...	...	×	...
**Litocheira integra* (Miers)	×	×	...	×	×	...	...	...	...
Paranotonyx curtipes, Nob.	×	...	...	...	...	...	...	...	...
Xenophthalmodes moebii, Richt	×	...	...	×	...	...	...	...	...
Family PINNOTHERIDÆ.									
Ostracotheres tridacnæ, Rüpp.	×	...	...	...	...	...	...	...	...
—— *affinis*, H. M.-Edw.	×	...	...	...	...	...	...	...	.
*—— *cynthiæ*, Nob.	×	...	...	...	...	...	...	...	...
Pinnotheres pectinicola, Bürg.	×	...	...	...	...	...	...	...	...
—— *purpureus*, Alc.	×	...	...	×	×	...	...	...	...
—— *pernicola*, Bürg.	×	...	...	...	...	...	...	...	...
—— *lutescens*, Nob.	×	...	...	...	...	...	...	...	...
—— *coutieri*, Nob.	×	...	...	...	...	...	...	...	...
—— *borradailei*, Nob.	×	...	...	...	...	...	...	...	...
—— *maindroni*, Nob.	×	...	...	...	...	...	...	...	...
*—— *pilumnoides*, Nob.	×	...	...	...	...	...	...	...	...
Durckheimia carinipes, de Man	×	...	...	...	...	...	...	...	...

† = *Eriphia lævimana*, Latr.; *fide* Rathbun, **1906**, p. 865.

TABLE I. (*con.*).

	Red Sea. Complete list, 1914.	Seychelles. Rathbun, **1911** (Gardiner's 'Sealark' collection). Miers, **1884** ('Alert' collection).	Persian Gulf. Nobili, **1907** (Bonnier et P. collection).	India. Alcock, 'Materials, **1895-1900**. Complete list.	Maldives and Laccadives. Borradaile, **1901-1903** (**3**) (Gardiner's collection).	Ceylon. Laurie, **1906** (Herdman's collection).	Torres Straits. Calman, **1900** (Haddon's collection).	Hawaiian Islands. Rathbun, **1906**. Complete list.	West Africa. Rathbun, **1900**. Complete list.
Family OCYPODIDÆ.									
Ocypode cordimana, Desm.	×	×	...	×	×	...	...	...	...
—— *ceratophthalma* (Pall.)	×	×	...	×	×	×	×	×	...
—— *jousseaumei*, Nob.	×	...	...	...	...	...	...	...	...
*—— *ægyptiaca*, Gerst.	×	...	×	...	...	...	...	...	...
Uca† *annulipes* (Latr.)	×	×	×	×	×	×	...	...	...
{ —— *inversa* (Hoffm.)	×	...	×	...	...	...	...	...	...
{ —— ——, var. *sindensis* (Alc.)	...	...	...	×	...	...	...	...	...
—— *tetragonon* (Herbst)	×	...	×	×	...	...	×	×	...
{ —— *marionis* (Desm.)	×	...	...	×	...	...	...	...	...
{ —— ——, var. *nitida*, Dana	×	...	...	×	...	...	...	...	...
**Dotilla sulcata* (Forsk.)	×	...	...	×	...	...	...	...	...
**Paraclistostoma leachii* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...
**Macrophthalmus verreauxi* H. M.-Edw.	×	...	...	×	×	...	...	...	...
—— *brevis* (Herbst)	×	...	...	...	...	...	...	...	...
*—— *graeffei*, A. M.-Edw.	×	...	...	...	...	...	...	...	...
*—— *depressus*, Rüpp.	×	...	×	×	...	...	...	...	...
Euplax (*Chænostoma*) *bosci* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...
Family HYMENOSOMIDÆ.									
Elamena mathæi (Desm.)	×	...	...	...	...	...	...	...	...
Family GRAPSIDÆ.									
{ *Grapsus grapsus* (Linn.)	×	...	×	×	...	...	...	...	×
{ —— —— *tenuicrustatus* (Herbst)	...	...	...	...	...	...	...	×	...
—— *strigosus* (Herbst)	×	...	...	×	...	...	...	×	...
Geograpsus grayi (H. M.-Edw.)	×	×	...	×	×	...	...	...	...
**Metopograpsus messor* (Forsk.)	×	×	×	×	...	×	×	×	×
Brachynotus harpax, Hilg.	×	...	...	...	...	...	...	...	...
Planes minutus (Linn.)	×	...	...	...	×	...	...	×	×
Pseudograpsus erythræus, Kossm.	×	...	...	...	...	...	...	...	...
Cyclograpsus lophopus, Nob.	×	...	...	...	...	...	...	...	...
Sesarma (*Sesarma*) *jousseaumei*, Nob.	×	...	...	...	...	...	...	...	...
{ *Plagusia depressa* (Herbst)	...	...	...	...	...	...	...	...	×
{ —— ——, var. *tuberculata*, Lam.‡	×	×	...	×	×	...	...	×	...
Percnon § *planissimum* (Herbst)	×	×	...	×	×	×	...	×	×
Family PALICIDÆ.									
Palicus jukesii (Wh.)	×	×	...	×	×	×	×	...	...
*—— *whitei* (Miers)	×	×	...	×	...	...	×	...	...
Family HAPALOCARCINIDÆ.									
Cryptochirus coralliodytes, Hell.	×	...	...	...	×	...	...	...	...

† *Gelasimus*, Latr., 1817 = *Uca*, Leach, 1814; see Rathbun, **1897**, p. 154, and Steb., **1905** (**1**) p. 39.
‡ For use of *tuberculata*, Lam., in preference to *squamosa*, Hbst., see Rathbun, **1906**, p. 841.
§ *Leiolophus*, Miers, 1876 = *Percnon* Gistel, 1848; see Rathbun, **1900**, p. 281.

The following is a summary of Table I. :—

TABLE II.

	Red Sea. Complete list, 1914.	Seychelles. Rathbun, **1911** (Gardiner's 'Sealark' [collection]). Miers, **1884** ('Alert' collection).	Persian Gulf. Nobili, **1907** (Bonnier et P. collection).	India. Alcock, 'Materials,' **1895-1900**. Complete list.	Maldives and Laccadives. Borradaile, **1901-1903 (3)** (Gardiner's collection).	Ceylon. Laurie, **1906** (Herdman's collection).	Torres Straits. Calman, **1900** (Haddon's collection).	Hawaiian Islands. Rathbun, **1906**. Complete list.	West Africa. Rathbun, **1900**. Complete list.
Tribe BRACHYURA.									
Subtribe Oxystomata	30	21 (6)	7 (3)	113 (17)	21 (4)	38 (5)	9 (2)	16 (2)	13 (1)
Family Calappidæ	5	6 (2)	...	15 (5)	6 (3)	7 (2)	1 (1)	6 (2)	5 (1)
Leucosiidæ	23	14 (3)	6 (2)	82 (10)	14 (0)	28 (2)	8 (1)	8 (0)	5 (0)
Dorippidæ	1	1 (1)	1 (1)	11 (1)	1 (1)	2 (1)	...	2 (0)	2 (0)
Raninidæ	1	...	...	5 (1)	...	1 (0)	...	...	1 (0)
Subtribe Dromiacea	8	11 (2)	3 (2)	29 (6)	7 (2)	10 (4)	...	...	3 (0)
Superfamily Dromiidea	8	10 (2)	3 (2)	21 (6)	7 (2)	10 (4)	...	...	3 (0)
Family Homolodromiidæ	...	...	...	1 (0)	...	...	...	...	...
Dromiidæ	8	6 (2)	3 (2)	18 (6)	7 (2)	10 (4)	...	...	3 (0)
Dynomenidæ	...	4 (0)	...	2 (0)	...	...	...	...	...
Superfamily Homolidea	...	1 (0)	...	8 (0)	...	...	...	...	...
Family Homolidæ	...	...	...	6 (0)	...	...	...	...	...
Latreillidæ	...	1 (0)	...	2 (0)	...	...	...	...	...
Subtribe Brachygnatha	222	238 (85)	58 (41)	459 (117)	162 (67)	147 (56)	74 (40)	187 (59)	78 (6)
Superfamily Oxyrhyncha	34	57 (12)	10 (5)	112 (18)	29 (9)	50 (17)	24 (10)	28 (9)	11 (0)
Family Hymenosomidæ	1	1 (0)	...	5 (0)	1 (0)	1 (0)	...	...	...
Mamaiidæ	22	44 (9)	7 (4)	76 (13)	22 (7)	34 (12)	21 (8)	20 (6)	7 (0)
Parthenopidæ	11	12 (3)	3 (1)	31 (5)	6 (2)	15 (5)	3 (2)	8 (3)	4 (0)
Superfamily Brachyrhyncha	188	181 (73)	48 (36)	347 (99)	133 (58)	97 (39)	50 (30)	159 (50)	67 (6)
Family Corystidæ	...	...	...	1 (0)	...	1 (0)	...	...	...
Portunidæ	35	34 (11)	9 (7)	63 (22)	19 (7)	33 (13)	8 (7)	27 (13)	12 (1)
Potamonidæ	...	...	...	...	...	...	...	1 (0)	16 (0)
Atelecyclidæ	...	2 (0)	...	4 (0)	2 (0)	1 (0)	1 (0)	4 (0)	1 (0)
Trichiidæ	...	...	...	...	...	...	...	...	...
Cancridæ	...	...	...	...	...	...	...	...	...
Xanthidæ	107	120 (51)	25 (21)	147 (56)	86 (39)	46 (21)	33 (18)	89 (28)	13 (0)
Goneplacidæ	5	6 (2)	3 (1)	29 (3)	5 (1)	3 (0)	...	3 (1)	...
Pinnotheridæ	12	...	2 (0)	11 (1)	2 (1)	1 (0)	...	...	1 (0)
Ptenoplacidæ	...	...	...	1 (0)	...	...	...	...	...
Palicidæ	2	3 (2)	...	5 (2)	1 (1)	2 (1)	3 (2)	3 (0)	...
Grapsidæ	11	10 (4)	2 (2)	48 (6)	10 (4)	5 (2)	2 (1)	23 (6)	16 (5)
Gecarcinidæ	...	...	1 (0)	5 (0)	1 (0)	...	...	1 (0)	2 (0)
Ocypodidæ	15	5 (3)	6 (5)	33 (9)	5 (4)	5 (2)	2 (2)	7 (2)	6 (0)
Hapalocarcinidæ	1	1 (0)	...	...	2 (1)	...	1 (0)	1 (0)	...
Total species	260	270	68	601	190	195	83	203	94
Number of species known from Red Sea	260	93	46	140	73	65	42	61	7
Species known from Red Sea expressed as percentage of total species	100 %	34 %	68 %	23 %	38 %	33 %	50 %	30 %	7 %

The first number in each column of the Table on p. 417 gives the number of species recorded from the source in question, the number in brackets gives the number of these which are known to occur also in the Red Sea.

Table II. is based upon Borradaile's classification (Borradaile, **1907**, p. 477 *et seq.*). Elsewhere in this paper I have arranged the material in Nobili's order, to facilitate comparison with his 'Faune Carcinologique de la Mer Rouge.'

It will be seen that the affinity of the Red Sea crabs is strongest with those of the Persian Gulf, 68 per cent. of the species recorded from the latter locality having also been recorded from the Red Sea.

The homogeneity of the Indo-Pacific region is illustrated by the fact that in places so far apart as Seychelles and the Hawaiian Islands the percentage of crabs common to the Red Sea is very similar, approximately 33 per cent. in each case, that this per cent. occurs at Ceylon and a fairly similar one at the Maldives and Laccadives. India is below and Torres Straits distinctly above this average figure. In estimating the significance of these per cents. one notes that the Red Sea, having been very fairly explored by a variety of collectors, is a good standard; but, on the other hand, one must bear in mind that other populations may have been sampled under different conditions, and it will be noted that the Torres Straits result, which appears somewhat anomalous, is associated with a comparatively short list. If allowance were made for these possible sources of error, the similarity might be even more striking. But taking the figures at face value, certain points stand out clearly: (1) the comparative similarity of the crabs over the whole Indo-Pacific area; (2) the almost entire lack of specific resemblance between the crabs of the Red Sea and those of West Africa; (3) omitting Persian Gulf as being in the immediate vicinity of the Red Sea, the Indo-Pacific figures suggest that one may prophesy with a probable error of $\pm$ 5 or 6 that 35 is the most likely percentage of species common to the Red Sea which will be found in a collection of say 200 species of crabs from any hitherto insufficiently investigated portion of the Indo-Pacific Region; the odds are about 20 to 1 against the error in such a prophecy being greater than $\pm$ 15. One may also prophesy with a probable error of $\pm$ 2 or 3 that 35 is the most likely average percentage of species common to the Red Sea which will be found on examining six further samples of Indo-Pacific crabs of similar numbers to those which I have considered; the odds are about 20 to 1 against the probable error of such a prophecy being greater than $\pm$ 7. The number of samples I have considered is of course small, and the attempt to give numerical precision to the degree of homogeneity of the Brachyuran fauna of the coral zone presents certain intricacies not considered here, but the figures I give are, I believe, not without some value and may form the basis of further investigation upon similar lines.

The West African forms recorded from the Red Sea comprise only

Calappa gallus (Herbst), *Grapsus grapsus* (Linn.), *Planes minutus* (Linn.), *Percnon planissimum* (Herbst), *Metopograpsus messor* (Forsk.), *Plagusia depressa* (Herbst), and *Thalamita integra*, Dana, of which the first four are of little or no account, owing to their exceptionally wide distribution, and the last two are varietally distinct.

To save frequent repetition, I give here a list of stations from which the present collection was made, the latitudes of which I have estimated approximately.

Crossland's maps, published in the present volume of this Journal, pages 6 and 15, and Plates **28**, **29**, and **30**, should be consulted.

I. Suez. Lat. 28° N.
- A. Suez mud-flats.
- B. Suez flats and docks. Dec. 1904.
- C. Suez mud-flats; washings of weed and sponge. The washings included an abundance of small and very large Amphipoda, some Isopoda, not many Brachyura, only two or three Macrura, and very few small Polychæta, also numerous Foraminifera.
- D. Suez docks. From beneath a floating stage which had been in the docks for several years. 26 Dec., 1904.
- E. Between Suez and Port Tewfik. Amongst stones of the embankment, bordering mud-flats, near high-tide level.
- F. As E plus Decapoda washed out of sponge and weed.
- G. Suez Bay. Trawled in 5 fathoms, from mud bottom.
- H. Suez Bay. Trawled in 5 fathoms, from mud bottom, among sponges.
- I. Suez Bay. From a red sponge taken from mud bottom in 10 fathoms.
- J. Suez. From among coral.
- K. Suez. Washed by fresh water from two coral colonies.
- L. Etuleh coral shoals, Suez Bay. Large areas covered by *Chama* and an Ostreid. In 1–3 fathoms.

II. Mersa Wadi Lehama, Egyptian coast. Lat. 24° 45′ N.

III. Cape Elba, the northern frontier of Sudan coast. Lat. 22° N.

IV. Mersa Abu Hamama. Lat. 21° 30′ N.

V. Khor Dongonab. Lat. 21° 11′ N. to lat. 20° 50′ N.
- A. Washed from nullipore and branched coral from the reef off Beacon Island. Lat. 20° 55′ N. 26 April, 1905. There were many Polychæta and Decapoda, comparatively few Amphipoda, and some Echinodermata in the same washings.
- B. Just west of Beacon Island. Lat. 20° 55′ N. Washed from nullipore dredged in 3–5 fathoms, 26 April, 1905. In the same washings were many Decapoda and Polychæta, especially the

TABLE III.

		Station I. Suez. Lat. 28° N.	Station II. Mersa Wadi Lehama. Lat. 24° 45′ N.	Station III. Cape Elba. Lat. 22° N.	Station IV. Mersa Abu Hamama. Lat. 21° 30′ N.	Station V. Khor Dongonab. Lat. 21° 11′ N. to 20° 50′ N.	Station VI. Mersa Ar-rakiya. Lat. 20° 15′ N.	Station VII. Suakin Harbour. Lat. 19° 8′ N.	Station VIII. Shubuk. Lat. 18° 52′ N. to 18° 43′ N.	Station IX. Tella Tella Kebira. Lat. 13° 48′ N.	Station X. Agig. Lat. 18° 13′ N.	Locality indefinite. Lat. 28° N. to 18° 13′ N.
1.	*Dromidia unidentata* (Rüpp.)	...	...	...	...	...	×	...	...	...	...	...
2.	*Cryptodromia hilgendorfi*, de Man	...	...	...	...	...	...	...	...	...	×	...
3.	—— *gilesii* (Alc.)	...	×	...	...	...	...	...	...	...	...	...
4.	*Calappa hepatica* (Linn.)	...	...	...	...	...	...	×	×	...	...	...
5.	*Nucia pulchella* (A. M.-Edw.)	...	...	...	...	×	...	...	...	...	...	...
6.	*Persephona fugax* (Fabr.)	...	...	...	...	...	...	...	×	...	...	...
7.	*Leucosia signata*, Pauls.	...	×	...	...	...	...	...	×	...	...	...
8.	*Dorippe dorsipes* (Linn.)	×	...	...	...	...	...	...	...	...	...	...
9.	*Notopus dorsipes* (Fabr.)	...	...	...	...	×	...	...	...	...	...	...
10.	*Camposcia retusa*, Latr.	...	...	...	...	×	...	...	...	...	...	...
11.	*Acanthonyx elongatus*, Miers	...	...	...	...	...	...	...	...	×	...	...
12.	*Herbstia corniculata*, Klunz.	...	...	...	...	×	...	...	...	...	...	...
13.	*Stilbognathus erythræus*, v. Mart.	...	...	...	...	×	...	...	...	...	...	...
14.	*Ophthalmias curvirostris* (A. M.-Edw.)	...	...	...	...	...	...	×	...	...	...	...
15.	*Cyphocarcinus minutus*, A. M.-Edw.	...	...	...	...	...	...	...	×	...	...	...
16.	*Parthenope horrida* (Linn.)	...	...	...	...	...	...	...	×	...	...	...
17.	*Lambrus* (*Aulacolambrus*) *hoplonotus*, Ad. & Wh.	...	×	...	...	...	...	...	×	...	...	...
18.	—— (*Rhinolambrus*) *pelagicus*, Rüpp.	...	×	...	...	...	...	...	...	...	...	...
19.	*Caphyra monticellii*, Nob.	...	...	...	...	...	...	...	×	...	...	...
20.	*Lupa alcocki* (Nob.)	×	...	...	...	...	...	...	...	...	...	...
21.	*Charybdis erythrodactyla* (Lam.)	...	...	...	...	...	...	×	...	...	...	...
22.	*Thalamita poissonii* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...	...	...
23.	—— *admete* (Herbst), var. *savignyi*, A. M.-Edw.	...	...	...	...	×	...	...	...	...	×	...
23*a*.	—— ——, var. *intermedia*, Borr.	...	...	...	...	...	...	...	...	...	×	...
24.	—— *integra*, Dana	...	...	...	...	...	...	×	...	...	...	...
25.	—— (*Thalamitoïdes*) *tridens*, A. M.-Edw., var. *spinigera* (Nob.)	...	...	...	...	...	...	...	...	...	...	×
26.	*Podophthalmus vigil* (Fabr.)	...	...	...	×	...	...	...	...	...	...	...

27.	*Carpilius convexus* (Forsk.)	...	...	...	...	...	...	×	...	...	...	...
28.	*Carpilodes lævis*, A. M.-Edw.	...	...	...	...	...	...	...	...	...	...	×
29.	—— *rugatus* (H. M.-Edw.)	...	...	...	...	...	...	×	...	×	...	...
30.	*Atergatis roseus* (Rüpp.)	...	...	...	...	×	...	...	...	...	...	×
31.	*Platypodia anaglypta* (Hell.)	...	...	...	...	×	...	...	...	...	...	...
32.	*Zosimus æneus* (Linn.)	...	...	...	...	...	...	×	...	...	...	...
33.	*Xantho distinguendus*, de Haan	×	...	...	...	...	...	...	...	...	...	×
34.	—— *hydrophilus* (Herbst)	...	...	...	...	×	...	×	...	...	...	...
35.	*Etisus lævimanus*, Rand.	...	...	...	...	...	...	...	...	...	...	×
36.	*Actæa tomentosa* (H. M.-Edw.)	...	...	...	...	...	...	×	...	...	...	...
37.	—— *hirsutissima* (Rüpp.)	...	...	...	...	×	...	...	...	...	...	×
38.	—— *garretti*, Rath.	...	...	...	...	...	...	...	...	×	...	...
39.	—— *polyacantha* (Hell.)	...	...	...	...	×	...	×	...	...	...	...
40.	—— *granulata* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...	...	×
41.	—— *fossulata* (Gir.)	...	...	...	...	×	...	×	...	...	...	...
42.	*Chlorodiella niger* (Forsk.)	×	...	...	...	×	...	×	...	...	...	×
42 *a*.	—— ——, var. *cytherea* (Dana)	...	...	...	...	×	...	...	...	×	...	...
43.	*Phymodius ungulatus* (H. M.-Edw.)	...	...	...	...	...	...	×	...	...	...	...
44.	—— *sculptus* (A. M.-Edw.)	...	...	...	...	...	...	×	...	×	...	...
45.	*Chlorodopsis arabica*, n. sp.	...	...	...	...	×	×	...	...	...	×	×
46.	—— *spinipes* (Hell.)	...	...	...	...	×	...	×	...	...	...	...
47.	*Cymo andreossyi* (Aud. et Sav.)	×	...	...	...	...	...	×	...	...	...	...
48.	*Pilumnus propinquus*, Nob.	...	...	...	...	...	...	×	...	...	×	×
49.	*Actumnus setifer* (de Haan), var. *tomentosus*, Dana	...	...	...	...	×	...	×	...	...	×	×
50.	—— *bonnieri*, Nob.	...	...	...	...	...	...	...	×	...	×	...
51.	*Heteropanope vauquelini* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...	...	×
52.	*Trapezia cymodoce* (Herbst)	×	...	...	...	×	...	×	...	×	...	×
52 *a*.	—— ——, var. *maculata* (Macl.)	...	...	...	...	...	...	×	...	...	...	...
53.	*Tetralia glaberrima* (Herbst)	...	...	×	...	×	...	×	...	...	...	...
54.	*Libystes nitidus*, A. M.-Edw.	...	...	...	...	...	×	...	×	...	...	...
55.	*Litocheira integra* (Miers)	...	...	...	...	×	...	...	...	...	...	...
56.	*Ostracotheres cynthiæ*, Nob.	...	...	...	...	...	...	...	...	...	...	×
57.	*Pinnotheres pilumnoides*, Nob.	...	...	...	...	...	...	...	...	...	...	×
58.	*Ocypode ægyptiaca*, Gerst.	...	...	...	...	...	...	...	...	×	...	...
59.	*Dotilla sulcata* (Forsk.)	×	...	...	...	...	...	...	...	...	...	...
60.	*Paraclistostoma leachii* (Aud. et Sav.)	×	...	...	...	...	...	...	...	...	...	...
61.	*Macrophthalmus verreauxi*, H. M.-Edw.	...	...	...	...	...	...	...	×	...	...	...
62.	—— *graeffei*, A. M.-Edw.	...	...	...	...	...	...	...	×	...	...	...
63.	—— *depressus*, Rüpp.	×	...	...	...	...	...	...	...	...	...	...
64.	*Metopograpsus messor* (Forsk.)	×	...	...	...	...	...	...	...	...	...	...
65.	*Palicus whitei* (Miers)	...	×	...	...	...	...	...	...	...	...	...

latter, a few Amphipoda, a few Echinodermata, and some Foraminifera.

C. Engineer Island. Lat. 20° 50′ N. Washed from old coral and weed obtained from Reef Flat. The washings were composed mostly of Polychæta (Eunicidæ, Nereidæ, etc.) and Decapoda (mostly small Brachyura), only two or three Amphipoda, no mud.

D. Engineer Island. Lat. 20° 50′ N. Washed from a small bucketful of weed and coral dredged in 3 fathoms of water. The washings were very rich in everything.

E. Khor Dongonab. Among coral on reef.

F. Khor Dongonab.

G. Islet group, Khor Dongonab. From mud and coarse sand in 11 fathoms of water. This islet group is probably the same as "Four Islet Shoal" of Crossland's map (*loc. cit.* p. 15), which would place it just north of lat. 21° N.

VI. Mersa Ar-rakiya. Among coral in 1 fathom of water. Lat. 20° 15′ N.

VII. Suakin Harbour. Lat. 19° 8′ N.

A. Suakin Harbour.

B. Suakin Harbour. 26 Jan., 1905.

C. Suakin Harbour. Purchased from a fisherman.

D. Suakin Harbour. From coral, 1905.

E. Suakin Harbour, near Customs' landing. From muddy bottom, in 5 fathoms of water.

VIII. Shubuk. Lat. 18° 52′ N. to 18° 43′ N.

A. Mersa Makdah in Shab-ul-Shubuk. 16 Feb., 1905.

B. Passage south of Mersa Makdah in Shab-ul-Shubuk. From a colony of coarse Campanularian Hydroids, overgrown with Algæ, brought up by a diver. In the washings there were also great quantities of Amphipoda, but very little else, a few Polychæta, and a Planarian; the mud, however, is rich in Foraminifera, the lighter mud contains very minute Amphipoda.

C. We Shubuk, north-east corner. 16 Feb., 1905.

D. We Shubuk, south-east corner. 16 Feb., 1905.

E. "Dredge washings, 17 Feb., 1905." No locality is given, but records were made by Crossland on the previous day from north-east corner of We Shubuk, south-east corner of We Shubuk, and Mersa Makdah in Shab-ul-Shubuk.

IX. Tella Tella Kebira, a small group of islands in the northern part of Suakin Archipelago. Lat. 18° 48′ N.

A. Tella Tella Kebira. Washed from the half-loose coral fragments and nullipore which compose the edge of the Southern Reef. The washings were rich generally, minute Brachyura and Polychæta very numerous. 3 March, 1905.

B. Tella Tella Kebira. From sand. The fauna includes the common shore hermit-crabs, which live above high-tide level, and the yellow land-crab, so abundant on the sand cays at Khor Dongonab and elsewhere, wherever there is sand for its burrows.

X. Agig. Lat. 18° 13′ N. From among coral in $4\frac{1}{2}$ fathoms of water. Agig is close to the southern frontier of the Sudan.

The distribution of the species in the present collection among the above Stations is set out in Table III. (pp. 420–421).

As regards literature, I have referred in every case to some good description—in Alcock's 'Materials,' whenever possible. I have included in the synonymies all references to Nobili, **1906**, and Klunzinger, **1906**, the two most recent accounts of Red Sea Brachyura. Most references of earlier date will be found in the works just named, but I have added a few others. The more recent literature on Indo-Pacific Brachyura has been referred to as has appeared desirable. Useful lists of general carcinological literature are given in Alcock, **1901**, Klunzinger, **1906**, and Ihle, **1913**. Important discussions on nomenclature will be found in Rathbun, **1897**, and in Stebbing's 'South African Crustacea,' in which latter also are notes on classification and very useful synonymies. Borradaile **1902** (**1**) contains suggestive remarks on varieties.

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Subtribe DROMIACEA.

Family DROMIIDÆ.

Genus DROMIDIA, *Stimpson*, 1859, *emend. Borradaile*, 1903.

1. DROMIDIA UNIDENTATA (*Rüppell*, 1830). *See* Alcock, **1899** (**2**), p. 139.

Dromia unidentata, Alcock, *loc. cit.*
Dromidia unidentata, Nobili, **1906**, p. 145.
Dromidia unidentata, Ihle, **1913**, p. 31.

Locality. Station VI., 1 ♂ [1] *.

Remarks. C.l.† 22 mm., C.b. 22 mm., 1st W.L. 34 mm., 2nd W.L. 32 mm., 3rd W.L. 20·5 mm., 4th W.L. 25 mm.

The specimen is of the same order of size as those described by Alcock, but his statement regarding the relative lengths of the walking-legs is that "the fourth (last) pair of legs are not so very much shorter than either of the first two pairs and are very much longer than the third pair."

Genus CRYPTODROMIA, *Stimpson*, 1859.

2. CRYPTODROMIA HILGENDORFI, *de Man*, 1887. *See* Alcock, **1899** (**2**), p. 145.

Dromia (*Cryptodromia*) *Hilgendorfi*, Alcock, *loc. cit.*
Cryptodromia Hilgendorfi, Nobili, **1906**, p. 146.
Cryptodromia hilgendorfi, Ihle, **1913**, p. 45.

Locality. Station X., 1 ♀ ovig. [2].

Remarks. C.l. 12·5 mm., C.b. 12·5 mm. Alcock describes the carapace as being longer than broad in two specimens—a male and a female—from the Persian Gulf. In the present specimen this is not the case, nor is it so in an example from Ceylon (Laurie, **1906**, p. 352), where C.b. ÷ C.l. = 1·03. The two lateral teeth of the front are less prominent in the present example than in the one from Ceylon just named.

My specimens agree with those of Nobili in having the outer orbital angle more prominent and sharper than represented in de Man's figure; Alcock says that this region is not dentiform, it is in the present specimen at least sub-dentiform.

* The collection is housed in the Museum of the Dept. of Zoology, University of Liverpool.
† Abbreviations are those used by Laurie, **1906**, p. 350.

3. Cryptodromia gilesii (*Alcock*, 1899). *See* Alcock, **1899** (2), p. 146.

Dromia (*Cryptodromia*) *Gilesii*, Alcock, *loc. cit.*
Cryptodromia Gilesii, Alcock, **1901**, p. 54, pl. 3. fig. 13.
? Nec *Cryptodromia granulata*, Nobili, **1906**, p. 147, pl. 9. fig. 5.

Locality. Station II., 1 ♂ apparently adult [3].

Remarks. The specimen agrees with Alcock's description. C.l., including frontal teeth, 9·5 mm., C.b. 10 mm.

The species is new to the Red Sea, it has hitherto been recorded only from the Malabar coast in 29 fathoms by Alcock.

It has in many of its characters a suspicious resemblance to *Cryptodromia granulata*, the *Epidromia granulata* of Kossmann (Kossmann, **1880**, p. 69; and Nobili, *loc. cit.*). The two species are evidently, as pointed out by Nobili, very closely related, but, though it is possible that they may come later to be regarded as one, the published evidence yet available does not in my view warrant one in uniting them. It may be that there is little difference beyond the form of the front, but this is markedly different. In Alcock's species the lateral frontal teeth are much longer and the supraorbital border more oblique. I have not had the opportunity of examining the type-specimens.

Subtribe **OXYSTOMATA.**

Family CALAPPIDÆ.

Genus Calappa, *Fabricius*, 1798.

4. Calappa hepatica (*Linnæus*, 1764). *See* Alcock, **1896**, p. 142.

Calappa hepatica, Nobili, **1906**, p. 148.
Calappa hepatica, Klunzinger, **1906**, p. 60.
Calappa tuberculata, Stimpson, **1907**, p. 165.

Localities. Station VII. E, 2 ♂ [4, 5]; Station VIII. A, 2 ♀ [6, 7]; Station VIII. C, 1 ♂ [8], 1 ♀ [9].

Remarks.

	♀ 6 juv.	♀ 9.	♀ 7 ovig.	♂ 8 juv.	♂ 4.	♂ 5.
C.l.	10·5	15·0	15·0	11·5	21·5	22·0 mm.
$C.b._1$	11·0	16·0	16·0	12·2	24·0	25·0 mm.
$C.b._2$	15·0	21·0	20·5	16·5	32·5	34·0 mm.
$C.b._1 \div C.l.$	·95	·94	·94	·94	·89	·88
$C.b._2 \div C.l.$	·70	·71	·73	·70	·66	·65

$C.b._1$ is measured immediately in front of the clypeiform expansions; $C.b._2$ is measured across the clypeiform expansions, from tip to tip of the fourth pair of teeth.

The specimens agree very well with Alcock's description. The emargination of the front is in all the specimens but slightly evident. The measurements given above indicate growth-change in the ♂ in regard to the ratio C.b. ÷ C.l.

Family LEUCOSIIDÆ.

Genus Nucia, *Dana*, 1852.

5. Nucia pulchella (*A. Milne-Edwards*, 1873). *See* Nobili, **1906**, p. 163.

Locality. Station V. A, 1 ♂ [10].

Remarks. C.l. 3 mm., C.b. 3·5 mm., frontal b. 1·1 mm. Only two other examples of the species have been recorded. The present specimen is of the same size as that of Nobili from the Red Sea; A. Milne-Edwards's type-specimen from the Fiji Islands has C.l. 5·5 mm. and C.b. 6 mm.

Genus Persephona, *Leach*, 1817.

Includes *Myra*, Leach, 1817; *teste* Rathbun.

6. Persephona fugax (*Fabricius*, 1798). *See* Alcock, **1896**, pp. 202 and 204.

Myra fugax, Alcock, *loc. cit.* p. 202.
Myra pentacantha, n. sp.?, Alcock, *loc. cit.* p. 204.
Myra fugax, Nobili, **1906**, p. 164.
Myra fugax, Klunzinger, **1906**, p. 73.
Myra fugax, Laurie, **1906**, p. 360.
Myra fugax, Stimpson, **1907**, p. 152.
Persephona fugax, Rathbun, **1911**, p. 201.

Locality. Station VIII. A, 1 ♀ juv. [11].

Remarks. C.l. including posterior spine, 11 mm.; Ch.l. 19 mm.; C.l. ÷ Ch.l. = 1·73. The specimen appears to be a late *pentacantha* stage, the spine on either postero-lateral margin above the last pair of legs is slightly indicated.

I agree with Nobili in believing that *Persephona pentacantha*, very doubtfully created by Alcock, is in reality the young stage of *Persephona fugax*.

Genus Leucosia, *Fabricius*, 1798.

The adoption of *Leucosides*, Rathbun, 1897, as a name for this genus depends upon one's acceptance, with Rathbun, of Latreille's examples of genera in 1810 as specifications of type (Rathbun, **1897**, p. 160). I agree with Stebbing (Stebbing, **1902**, p. 11, and **1908**, p. 11) in not so accepting them.

7. Leucosia signata, *Paulson*, 1875. *See* Klunzinger, **1906**, p. 69.

Leucosia signata, Nobili, **1906**, pp. 163 and 344.
Leucosia fuscomaculata, Klunzinger, *loc. cit.*

Localities. Station II., 1 ♂ [12]; Station VIII. A, 8 ♀ [13–20], 10 ♂ [21–30]; Station VIII. D, 1 ♀ [31].

Remarks. The specimens comprise 5 ♂ juv., 6 ♂ adult, 6 ♀ juv., and 3 ♀ adult, non-ovig.

The adult females have a rounded posterior border ; in all the adult males the angles of the posterior border, though rounded, are a little prominent ; in all the young of both sexes the posterior border is straight with somewhat prominent angles.

The measurements given below show that the size of the adult specimen is of the same order as given by Nobili :—

	♀ adult.	♀ adult.	♂ adult.	♂ adult.
C.l.	19·0	22·5	19·5	21·0 mm.
C.b.	16·0	19·0	16·5	17·5 mm.
C.l. ÷ C.b.	·84	·84	·84	·83

In adult ♂ 30 (C.l. 19 mm.), the granules on the postero-lateral border of the carapace are not continued further back than the first pair of walking legs, above which they fade away. The specimen has the M well marked on the carapace and is clearly for all other reasons also to be placed in this species.

Family DORIPPIDÆ.

Genus Dorippe, *Fabricius*, 1798.

8. Dorippe dorsipes (*Linnæus*, 1764). *See* Alcock, **1896**, p. 277.

Dorippe dorsipes, Nobili, **1906**, p. 172.
Dorippe dorsipes, Nobili, **1907**, p. 95.
Dorippe dorsipes, Laurie, **1906**, p. 367.
Dorippe quadridens, Stimpson, **1907**, p. 167.

Locality. Station I. H, 1 ♀ immature [32].

Remarks. C.l. 8·25 mm.

The spine at the outer angle of the orbit reaches distinctly less far forward than the frontal teeth ; the large spine at the inner canthus projects the same distance forwards as the frontal teeth. The condition of the spine at the outer angle of the orbit appears to be characteristic of the earlier growth stages (Laurie, *loc. cit.*).

Family RANINIDÆ.

Genus Notopus, *de Haan*, 1841.

9. Notopus dorsipes (*Fabricius*, 1793). *See* Alcock, **1896**, p. 290.

Locality. Station V. G, 2 ♀ [33, 34].

Remarks. ♀ 34, C.l. 19 mm., C.b. across base of antero-external spines 13 mm., fronto-orbital border 8·5 mm. ; ♀ 33, C.l. 13 mm., C.b. 9 mm., fronto-orbital border 6 mm.

Alcock's description reads obscurely as regards the spines of the anterior border of the carapace; there are five spines on the fronto-orbital border, as he describes, but the spine forming the antero-external angle of the carapace on either side is not the outermost of the above series but an additional one, making a series of seven spines in all along the anterior border of the carapace. This is seen quite clearly in de Haan's figure (**1841**, pl. xxxv. fig. 5). It is presumably also not the ischium but the merus of the chelipeds which Alcock intends to describe as trigonal, somewhat swollen, and having its outer surface tattooed with linear dents with hairy edges.

This is the first record of any member of the family Raninidæ from the Red Sea.

Subtribe **BRACHYGNATHA.**

Superfamily Oxyrhyncha.

Family MAMAIIDÆ.

=*Maiidæ*, see Stebbing, **1905 (1)** p. 22, and **1910**, p. 290. I use the word, however, in its wider sense, not as =Alcock's Maiinæ.

Genus Camposcia, *Latreille*, 1829.

10. Camposcia retusa, *Latreille*, 1829. *See* Alcock, **1895**, p. 184.

Camposcia retusa, Nobili, **1906**, p. 172.
Camposcia retusa, Klunzinger, **1906**, p. 15, pl. 1. fig. 1.
Camposcia retusa, Laurie, **1906**, p. 371.
Camposcia retusa, Stimpson, **1907**, p. 19.

Locality. Station V. E, 1 ♀ ovig. [35].

Remarks. C.l. 34 mm. It is encrusted, as is usual in this species, with a very considerable quantity of sponges, etc.

Genus Acanthonyx, *Latreille*, 1829.

11. Acanthonyx elongatus, *Miers,* 1877. *See* Miers, **1877**, p. 673, pl. 69. fig. 1.

Acanthonyx elongatus, Nobili, **1906**, p. 172.
Acanthonyx elongatus, Klunzinger, **1906**, p. 22.
Acanthonyx consobrinus, Paulson, **1875**, p. 7, pl. 3. fig. 1 (nec *A. consobrinus,* A. M.-Edw., 1863); *fide* Klunzinger, *loc. cit.*

Locality. Station IX. B, 1 ♂ probably immature [36].

Remarks. C.l. including rostrum 22·5 mm.

It differs from Miers's description and figure in (*a*) the tubercles of the carapace, there being three on the gastric region, one on the cardiac region, a small one on either side of the cardiac region and a trace of one on the intestinal (post-cardiac) region; (*b*) the small middle tooth of the lateral border of the carapace is more distinct than in Miers's figure and so also are

the curves in front of and behind this. The specimen falls, however, under Klunzinger's description.

Klunzinger gives some notes on the synonymy of the species. He considers that the specimens which Paulson put under *A. consobrinus* in 1875 really belong to the present species, but that *A. consobrinus* of A. Milne-Edwards, 1863, is distinct. From this it would follow that the latter species has not been recorded from the Red Sea and should therefore be deleted from Nobili's list.

A. elongatus has not been recorded outside the Red Sea.

Genus Herbstia, *H. Milne-Edwards*, 1834.

12. Herbstia corniculata, *Klunzinger*, 1906. (Plate **44**. fig. 2.) *See* Klunzinger, **1906**, p. 27, pl. 1. figs. 4 *a–b*.

Locality. Station V. A, 1 ♂ probably adult [37].

Remarks. C.l. including rostrum 7·5 mm., C.b. 8 mm. The fingers gape proximally as shown in the figure. Lower border of propus 3·5 mm.

Klunzinger's specimens are ♀. The present specimen is the only other recorded example of the species and the first ♂ recorded. The species has thus not been found outside the Red Sea.

Genus Stilbognathus, *von Martens*, 1866.

13. Stilbognathus erythræus, *von Martens*, 1866. *See* Klunzinger, **1906**, p. 25.

Stylbognathus erythræus, Nobili, **1906**, p. 176.

Locality. Station V. E, 1 ♂ [38], 1 ♀ ovig. [39].

Remarks. ♂, C.l. excluding the rostral horns but including the posterior triangle 22 mm., rostral horn 7 mm. Cheliped of the enlarged "breeding" type, the fingers gaping a good deal proximally: H.l. 6 mm., lower border of propus 11 mm., propus height 5·5 mm.; ♀ 39, C.l. 21 mm., rostral horn 5 mm.

Kossmann (**1877**, p. 15, pl. 1. fig. 1) gives a useful photograph of a dorsal view of the animal.

The species has not been recorded outside the Red Sea.

Genus Ophthalmias, *Rathbun*, 1897.

= *Stenocionops*, Latr., 1825, *et auct.*, not Leach, 1823, which latter replaces *Pericera*, Latr., 1825; *see* Rathbun, **1897**, p. 157.

14. Ophthalmias curvirostris (*A. M.-Edw.*, 1865). (Plate **45**. fig. 4.) *See* Klunzinger, **1906**, p. 24.

Stenocionops curvirostris, Nobili, **1906**, p. 177.
Stenocionops curvirostris, Nobili, **1907**, p. 108.
Stenocionops curvirostris, Klunzinger, **1906**, *loc. cit.*
? *Stenocionops cervicornis*, von Martens, **1866**, p. 379; *nec* Herbst, 1803.

Locality. Station VII. E, 2 ♀ (No. 41 ovig.) [40, 41].

Remarks. ♀ 41 ovig.: C.l. excluding rostral horns 23 mm., rostral horn l. 7 mm., eye-stalk l. measured from inner orbital angle 6·5 mm., and supra-ocular spine l. measured also from inner orbital angle 7 mm., R.l. ÷ C.l. = ·30; ♀ 40 has C.l. 9 mm., R.l. 3·5 mm., and R.l. ÷ C.l. = ·39.

The following distinctions hold between the present specimens of *O. curvirostris* and specimens of *O. cervicornis*, Herbst, from Ceylon, examined by me (Laurie, **1906**, p. 383):—

1. The rostral horns are distinctly upturned at the tips in *curvirostris*, not in *cervicornis*. See Rathbun, however, as below.

2. The rostral horns are closely apposed in *curvirostris*, but in *cervicornis*, though the rostral horns are somewhat bowed outwards, their tips are well apart (*e.g.* 8 mm. in a specimen with C.l. 45 mm.).

3. The triangular projection of the posterior border of the carapace is more broadly triangular and less elongate in *curvirostris*.

4. The form of the external maxillipedes presents two points of difference, both in regard to the ischium:—

(*a*) the ischium of *curvirostris* has a deep longitudinal groove on the exposed surface, there is in *cervicornis* only the merest trace of such a groove.

(*b*) in *cervicornis* the proximal portion of the inner margin of the ischium, just before the angle is reached, is strongly notched, so that a rounded window is formed when the two ischia are opposed, this window is open posteriorly as the proximal angles do not meet in the middle line, though each such angle bears a claviform seta and these meet across the middle line giving an appearance of completeness to posterior border of the window (Pl. **45**. fig. 5); in *curvirostris* the proximal angle of the inner border of the ischium is cut away and only very obscurely marked, so that the regions in question slope obliquely backwards away from each other and the window does not appear, the club-shaped setæ are present but are far from meeting in the middle line (Pl. **45**. fig. 4).

5. The eye-stalks and the supra-ocular spines are subequal in *curvirostris*, whereas in *cervicornis* the eye-stalks are quite distinctly the shorter of the two.

Of the above points of difference the first is of doubtful value, Rathbun (Rathbun, **1911**, p. 254) saying that the rostral horns have their tips recurved upward (but not that they are apposed) in a ♂ *cervicornis* from Amirante and a young ♀ from Seychelles which she describes. The condition of the ischia of the external maxillipedes may prove, however, to be a distinction of considerable importance.

I do not share Nobili's doubt as to the distinctness of the two species from one another.

The only record of *O. cervicornis* from the Red Sea is that of von Martens, and, on the other hand, *O. curvirostris* has not been recorded outside the Red Sea and Persian Gulf. As pointed out by Nobili, von Martens made his identification when probably unaware of Milne-Edwards's description of *O. curvirostris*, published only the previous year. It would be of interest to re-examine von Martens's examples.

Genus Cyphocarcinus, *A. Milne-Edwards*, 1868.

15. Cyphocarcinus minutus, *A. M.-Edw.*, 1868. (Plate **44**. fig. 3.) *See* Alcock, **1895**, p. 254.

> *Cyphocarcinus minutus*, A. Milne-Edwards, **1868**, p. 73, pl. 19. figs. 7–12.
> *Cyphocarcinus minutus*, Nobili, **1906**, p. 177.
> *Cyphocarcinus minutus*, Nobili, **1907**, p. 109.
> *Ixion capreolus*, Klunzinger, **1906**, p. 44.
> *Cyphocarcinus minutus*, Rathbun, **1911**, p. 255.

Locality. Station VIII. B, 1 ♀ [42].

Remarks. C.l. to base of rostral horns 7·5 mm., and to tip of rostral horns 9·25 mm., rostral horn l. 2 mm.

The figures which best represent the present specimen are those of Paulson (**1875**, pl. 2. fig. 1) of a young ♂, size not stated, given under the name of *Ixion capreolus*. In Paulson's figure, however, the gastric hump is less marked and the rostral horns are longer than in my ♀ specimen. Klunzinger translates Paulson's description.

Nobili (**1907**, *loc. cit.*) gives a useful account of the species.

The present specimen differs strikingly, in three respects more particularly, from A. Milne-Edwards's account of *C. minutus*: (*a*) it will be seen from my figure that in the present specimen the pre-gastric region slopes a little forward so that it is not hidden in a dorsal view of the animal, as described by Milne-Edwards, and affords a considerable contrast from his fig. 10, which is referred to by Nobili as well representing his own specimens; (*b*) the rostral horns are not pressed against each other in their basal portion as described by Milne-Edwards, but stand well apart, contrasting strongly with his figure 8; (*c*) the basal joint of the first antenna and the joint following, though of the same general type, are less shortened in the present example than in Milne-Edwards's figure, so that a distinctly different appearance results from a ventral view.

In regard to (*a*) above my specimen appears to be similar to Rathbun's 'Sealark' specimens from Amirante and Coetivy (*loc. cit.*), and in regard to (*b*) Rathbun's specimens appear in some degree intermediate between mine and that of Milne-Edwards.

The type-specimen of *Xenocarcinus tuberculatus* of White, in the British Museum, has the appearance of having had a similar arrangement, the 4th pair of walking-legs is present and, though the 3rd pair is lost, the basipodites which remain suggest that the legs pointed more backward than in Miers's figure (Miers, **1874**, pl. 2. fig. 1).

In the British Museum I find two unnamed males labelled "85.14. Aden, at low water. Presented by Major G. W. Yerbury." In these the rostral horns are longer than in the present example, being more as in Paulson's figure. Rathbun (*loc. cit.*) also finds the rostral horns longer in her ♂ than in her ♀ specimen. The two British Museum specimens are of the same size, C.l. 11 mm.; the chelipeds are enlarged in both, being apparently of the type appropriate to breeding males.

Family PARTHENOPIDÆ.

Genus PARTHENOPE, *Fabricius*, 1798.

For non-recognition of Weber, 1795, and consequent non-acceptance of *Daldorfia*, Rath., 1904, see Stebbing, **1905** (**2**), p. 332.

16. PARTHENOPE HORRIDA (*Linnæus*, 1758). *See* Alcock, **1895**, p. 279.

Parthenope horrida, Alcock, *loc. cit.*
Parthenope horrida, Nobili, **1906**, p. 179.
Parthenope horrida, Klunzinger, **1906**, p. 54.
Parthenope horrida, Stebbing, **1905** (**1**), p. 27.
Daldorfia horrida, Rathbun, **1906**, p. 886, pl. 14. fig. 5.
Daldorfia horrida, Rathbun, **1911**, p. 259.

Locality. Station VIII. E, 1 ♀ small [43].

Remarks. C.l. 14 mm., C.b. 19·25 mm., C.l. ÷ C.b. = ·73, larger (right) Ch.l. 25·5 mm., smaller (left) Ch.l. 23·5 mm., the right and left chelipeds are thus respectively 1·82 and 1·68 the length of the carapace.

The teeth on the upper margins of the meri of the walking-legs are triangular.

Fig. 1.

Parthenope horrida, ♀ 43. Sternal hollow, 3 mm. across.

The shape of the sternal hollow is shown in the accompanying text-figure.

Genus LAMBRUS, *Leach*, 1815.

For non-acceptance of *Parthenope*, Weber, 1795, see Stebbing, **1905** (2), p. 332.

17. LAMBRUS (AULACOLAMBRUS) HOPLONOTUS, *Adams & White*, 1848. *See* Alcock, **1895**, p. 273.

Lambrus (*Aulacolambrus*) *hoplonotus*, Alcock, *loc. cit.*
Lambrus (*Aulacolambrus*) *hoplonotus*, Laurie, **1906**, p. 389.
Parthenope (*Aulacolambrus*) *hoplonotus*, Rathbun, **1906**, p. 885.

Localities. Station II., 1 ♂ juv. [44]; Station VIII. A, 1 ♀ non-ovig., but probably adult [45]; Station VIII. C, 1 ♂ juv. [46].

Remarks.

	♀ 45.	♂ 46.	♂ 44.
C.l.	15·0	7·5	7·5
$C.b._1$	17·0	..	7·75
$C.b._2$	26·5	..	10·75
Lat. Epi. spine (post. bord.)	7·25	..	2·5
Ch.l.	38·0	19·5	19·5
$C.b._1 \div C.l.$	1·13	..	1·03
$C.b._2 \div C.l.$	1·77	..	1·43
$Ch.l. \div C.l.$	2·53	2·60	2·60
Lat. Epi. spine $\div$ C.l.	·48	..	·33

$C.b._1$ is measured across anterior bases and $C.b._2$ across tips of lateral epibranchial spines.

♂ 44 is well separated from the other two specimens. (*a*) All three specimens have the carapace set with rounded tubercles, but while in ♀ 45 and ♂ 46 these are strongly developed and well granulated they are in ♂ 44 less pronounced, and their granulation is inconspicuous; it follows that the latter specimen is much less rough in general appearance than either of the other two.

(*b*) The orbits have a very different appearance; in ♀ 45 and ♂ 46 the orbital margin bears a series of longitudinally elongated granulated tubercles which have somewhat the appearance of claws curving over the orbit, reminding one of the metal claws by which a jeweller sets a stone in a ring; in ♂ 44 there are simply a few granules which do not obscure the large triangular emargination of the dorsal margin of the orbit. Running back from the apex of this emargination the fissure is well seen in ♂ 44.

(*c*) The spines of the cheliped are smooth in ♂ 44; in ♀ 45 and ♂ 46 they are, in dorsal view, considerably granulated. The detail of the granulation is as follows: each spine of the inner border of the hand is quite covered with granules dorsally, the spines of the outer margin of the hand form a series in which there is a gradual transition from the distal one, which is granular to its base, to the proximal one, which is granular only at its tip;

on the wrist only the tips of the spines are granular, more particularly in the longer ones ; and on the arm there is a transition as in the hand, but in the reverse direction, *i. e.*, a trace at the tip of the two distal ones, in the next one there are in addition one to three granules about the middle of its length, in the next the outer half or more is granular, and in the most proximal member of the series the granules extend almost to the base.

(*d*) In ♂ 44 the lateral epibranchial spine appears to curve a little forwards, owing to the convexity of its posterior border, while in ♀ 45 and ♂ 46 it points in a straight line obliquely backward.

(*e*) In ♂ 44 the lateral epibranchial spines are relatively shorter than in ♀ 45. (In ♂ 46 they are damaged.)

(*f*) In ♂ 44 the lateral epibranchial spine is simple, while in ♀ 45 and ♂ 46 it bears on each side near its base a well-marked secondary spine (not to be confused with the quite separate spine to its inner side).

(*g*) The number of large spines on the outer margin of the hand differs, in ♂ 44 there are six while in ♀ 45 and ♂ 46 there are eight.

Miers (**1879**, pp. 22–4) describes several varieties of this species. Specimens 45 and 46 appear to come close to White's type-specimen from "Eastern Seas," described by Miers, while specimen 44 closely resembles Ceylon examples examined by me (*loc. cit.*) and comes close to var. *planifrons* (Ceylon) and var. *granulosus* (Phillipine Islands and Corregidor), both of Miers.

Although in my Ceylon examples the resemblance is to specimen 44 of the present collection, the tubercles of the carapace are sharper than in it, and the orbital border is more as in specimens 45 and 46.

Perhaps the most important of the contrasted characters in the above forms are the number of spines on the outer border of the hand and the condition of the lateral epibranchial spines.

L. hoplonotus has not hitherto been recorded from the Red Sea.

18. LAMBRUS (RHINOLAMBRUS) PELAGICUS, *Rüppell*, 1830. *See* Alcock, **1895**, p. 267.

> *Lambrus (Rhinolambrus) pelagicus,* Alcock, *loc. cit.*
> *Lambrus (Rhinolambrus) pelagicus,* Nobili, **1906**, p. 184.
> *Lambrus (Rhinolambrus) pelagicus,* Klunzinger, **1906**, p. 47
> *Lambrus (Rhinolambrus) pelagicus,* Laurie, **1906**, p. 389.

Locality. Station II., 1 ♂, small [47].

Remarks. C.l. 7·5 mm., C.b. 7·5 mm., Ch.l. 19·5 mm., Ch.l.÷C.l.=2·6. The cheliped length of this young ♂ agrees with that of a young ♀ of similar size from Ceylon (Laurie, *loc. cit.*).

Superfamily BRACHYRHYNCHA.

Family PORTUNIDÆ.

Genus CAPHYRA, *Guérin*, 1832.

19. CAPHYRA MONTICELLII, *Nobili*, 1901. (Plate **45.** figs. 1, 1 *a*.) *See* Nobili, **1901**, p. 10.

> *Caphyra Monticellii*, Nobili, *loc. cit.*
> *Caphyra Monticellii*, Nobili, **1906**, p. 188.

Locality. Station VIII. E, 1 (? ♂) [48].

Remarks. Probably ♂, the abdomen is missing. C.l. 5 mm., C.b. 5·75 mm., C.b. ÷ C.l. = 1·15. The left hand is much more massive than the right: in the left cheliped H.l. (upper bord.) 4 mm., F.l. (upper bord.) 2·5 mm., lower border propus 6 mm. and H. height 2·75 mm.; in the smaller cheliped the same measurements are 2·6, 2·6, 5, and 2 mm. respectively.

There are small blunt tubercles on the upper inner border of the ischium of the cheliped instead of spinules. There are only two spines on the lower inner border of the ischium of the smaller (right) cheliped, there are two tubercles in this position on the larger (left) cheliped. The four spines on the lower anterior border of the merus of the left cheliped are equal in size and of the same type as on the merus of the right cheliped. The tubercle on the outer surface of the palm at the region of the carpo-propal articulation is blunt, not spiniform. The upper border of the palm is as described by Nobili, but neither the well-developed crest nor the traces of a second one are present on the outer surface of the palm.

Thus this specimen differs from Nobili's specimen essentially (*a*) in the size and relations of the chelipeds, the left being much the more massive and its fingers much shorter in proportion to the palm; and (*b*) in having the armature of the hands less sharp.

The abdomen of the present specimen is missing. If my identification is correct and if the specimen is, as I take it to be, a male, then the above points of difference of the chelipeds from Nobili's description, which was of a female, may be in some part sex-differences; they may also be in part related to size. Nobili's type-specimen had C.l. 4 mm. and C.b. 5 mm.; it was taken 25 miles north of Massowah in 1893.

The front is asymmetrical in the present specimen, the outer tooth of the right frontal lobe being very inconspicuous, while that of the left lobe is distinct, though small.

Genus Lupa, *Leach*, 1813.

=*Neptunus*, de Haan, 1833. *See* Stebbing, **1902**, p. 11, and **1908**, p. 11.

20. Lupa alcocki (*Nobili*, 1905). (Plate **44**. figs. 1–1 *c*.) *See* Nobili, **1906**, p. 191.

Neptunus (Hellenus) Alcocki, Nobili, *loc. cit.*

Locality. Station I. B, 1 ♂ [49].

Remarks. C.l. 8 mm.; C.b. from tip to tip of the large 9th antero-lateral spines 16·25 mm., across the line of the angles between 8th and 9th antero-lateral teeth 12 mm.; Ch.l. 16 mm.; propus l. (inner lower bord.) 8·75 mm.

Of the three teeth on the outer surface of the wrist one is distal and spiniform and two are proximal and blunt.

A point not referred to by Nobili is that there is a break in the salient crest of the large lateral spine where it curves back on the carapace towards the cardiac region.

The chelipeds are of approximately equal length, but the right chela is the more massive.

The only other example of this species recorded is the male with C.l. 6·75 mm., which formed Nobili's type-specimen and was taken at Djibouti.

Genus Charybdis, *de Haan*, 1833.

=*Goniosoma*, A. M.-Edw., 1860; *see* Rathbun, **1897**, p. 161.

21. Charybdis erythrodactyla (*Lam.*, 1818). *See* Nobili, **1907**, p. 118, fig. 3.

Charybdis (Goniosoma) erythrodactyla, Nobili, **1906**, p. 194.
Thalamita pulchra, Randall, **1840**, p. 117, pl. 4; *see* Rathbun, *loc. cit.*
Charybdis erythrodactyla, Rathbun, **1906**, p. 872, pl. 4 (coloured).

Locality. Station VII. B, 1 ♀ immature [50].

Remarks. C.l. 16·25 mm., C.b. (across the region of the last antero-lateral spines) 25 mm.

Though the chelipeds are missing, and important characters are thus undeterminable, the specimen appears evidently to belong to *C. erythrodactyla*, agreeing with the group of small specimens described by Nobili (**1906**, p. 195).

There is granulation on the basal antennal joint both proximal and distal to the blunt laminar tubercle.

Genus Thalamita, *Latreille*, 1829.

22. Thalamita poissonii (*Audouin et Savigny*, 1826). *See* Alcock, **1899 (1)**, p. 81.

Thalamita Poissonii, Alcock, *loc. cit.*
Thalamita Poissonii, Nobili, **1906**, p. 205.
Thalamita Poissoni, Nobili, **1907**, p. 120.
Thalamita poissoni, Laurie, **1906**, p. 419.

Localities. Station I. B, 4 ♂ [51–54], 5 ♀ [55–59]; Station I. E, 1 ♂ probably adult [60]; Station I. G, 1 ♂ [61], 1 ♀ [62].

Remarks. The length of the carapace varies in the males from 11 to 16 mm. and from 11 to 17·5 mm. in the females.

In both sexes it is sometimes the right and sometimes the left cheliped which is the larger, thus it is the right in four of the males and three of the females, and the left in the remainder of the specimens.

I do not share Alcock's doubt as to the distinctness of this species from *T. chaptalii*. Points of difference are as follows:—

1. As pointed out by Alcock, the teeth of the antero-lateral border are in *T. poissonii* acute, and the last tooth is more spiniform and more prominent than the others.

2. As pointed out by Nobili, the fourth tooth of the antero-lateral border is in *T. poissonii* much smaller than the others.

3. Alcock notes that the teeth of the anterior border of the arm are in *T. poissonii* acute; this is so in the present specimens, in which they are three or four in number. So also are the other teeth of the cheliped acute, and this is conveniently seen in the case of the tooth on the upper surface of the propus, in front of the carpo-propal articulation. Borradaile (**1902** (**1**), p. 201) records, however, a male from Suvadiva which "has the spines on the fore edge of the meropodite of the cheliped blunt," as in *T. chaptalii*.

4. In place of the somewhat granular eminence on each antero-lateral portion of the gastric region in *T. chaptalii* there is in *T. poissonii* a short transverse granular ridge.

5. The present specimens contrast with those from the Gulf of Manaar placed by me (Laurie, *loc. cit.*) under *T. chaptalii* in the shape of the front; its outer limit is well marked and rounded in the present specimens instead of gently sloping, so that the anterior frontal margin is fairly straight transversely.

6. The hinder edge of the propodite of the last leg bears in *T. poissonii* several spinules, of which there is no trace in *T. chaptalii*. This difference is emphasized by Borradaile.

7. The setæ of the dorsal surface of the carapace are longer in the present specimens of *T. poissonii* than in the Gulf of Manaar examples of *T. chaptalii* mentioned above; the difference, though not great, is constant.

8. An additional point is the red coloration (spirit-specimens) of the upper mero-carpal point of articulation; this concerns both the articular process of the carpus and the margin of the articular cavity of the merus, and appears as a conspicuous red dot in a dorsal view of the animal as it lies in a position of rest. Colour in spirit is no doubt elusive, but in the present instance the red spot is clearly seen in all the specimens, but not to be made out at all in a series of 22 specimens of *T. chaptalii* from Gulf of Manaar which I have

before me, though these latter show traces of colour on the fingers just as clearly as do the present specimens.

23. THALAMITA ADMETE (*Herbst,* 1803), var. SAVIGNYI, *A. M.-Edw.*, 1861. *See* Alc. **1899** (**1**), p. 84 ; Nob. **1906**, p. 206 ; Borr. **1902** (**1**), p. 202.

Thalamita admeta, var. *savignyi*, Alcock, *loc. cit.*
Thalamita admeta, var. *Savignyi*, Nobili, *loc. cit.*
? *Thalamita admete*, Rathbun, **1906**, p. 874.

Locality. Station V.E, 1 ♀ [63]; Station X., 1 ♀ [64].

Remarks. Specimen 64 is immature, C.l. 11·5 mm., C.b. 19 mm.; it has lost its left cheliped. Specimen 63 is non-ovigerous, but appears to be mature, C.l. 14 mm., C.b. 22·75 mm.; its front is damaged.

The present examples have very strong resemblance also to var. *admete*, Herbst, 1803, but they fall within the limits of variation of specimens referred by Nobili to var. *savignyi*. One may note (*a*) the transverse ridges of the carapace are in sharp relief ; (*b*) the division between the two frontal lobes is not broad and deep (in specimen 63 this region is injured) ; (*c*) certain particulars in regard to the hands in specimen 63 (the left cheliped is lost in specimen 64), namely : the inner surface of each hand bears a median longitudinal granular ridge and the narrower (left) hand has, in addition, a second row of small granules below this, and the lower portion of its inner surface is also granular ; the lower margin of the larger hand is smooth save for a few obsolescent markings, that of the smaller is granular, the granulation being continuous with the granular portion of the lower part of the inner surface ; except for a few obsolescent granules the space between the two lower crests of the outer surface of the hand is smooth, a point of difference from Borradaile's Key (Borradaile, **1902** (**1**), p. 202); (*d*) each finger has a well-marked groove along its inner surface and the dactylus has the suggestion of a second groove above the other proximally ; (*e*) in the larger specimen the 4th antero-lateral tooth of each side, though far from obsolescent, is smaller than the others, being about one-half the size of the third ; in the smaller specimen it is rudimentary. From cases cited by Nobili it appears that the size of this tooth may be subject to considerable growth-change, assuming an increased relative size with the growth of the animal.

Rathbun (*loc. cit.*) describes three forms from the Hawaiian Islands, *edwardsi*, Borradaile, *admete*, Herbst, and *auauensis*, Rathbun, sp. nov., which come within the *admete* group, and to each she gives specific rank. She does not agree with the application of Herbst's name *admete* made by Alcock and by Borradaile, but believes it essential that forms included under it shall have a well-developed fourth side-tooth. One would like to know the sizes of the specimens which she discusses, and whether differences of the condition

of the fourth side-tooth hold as between large specimens or to what extent such differences may be due to growth-change. Rathbun remarks regarding the examples she puts under *T. admete* that "the description of *T. savignyi*, A. Milne-Edwards, applies very well to these specimens, except that the inner surface of the hand is not granular."

23 *a.* THALAMITA ADMETE (*Herbst*, 1803), var. INTERMEDIA, *Borr.*, 1902. *See* Borr. **1902 (1)**, p. 203; Nob. **1906**, p. 208.

> *Thalamita admeta*, var. *intermedia*, Borradaile, *loc. cit.*
> *Thalamita admeta*, var. *intermedia*, Nobili, *loc. cit.*

Locality. Station X., 2 ♂ [65, 66].

Remarks. Specimen 65 has C.l. 11·5 mm. Specimen 66 has C.l. 12·5 mm.

In specimen 66 the crest on the basal joint of the right antenna has four spinules, and that of the left antenna five spinules; specimen 65 is typical with three spinules on each side.

24. THALAMITA INTEGRA, *Dana*, 1852. *See* Alcock, **1899 (1)**, p. 85.

> *Thalamita integra*, Nobili, **1906**, p. 209.
> *Thalamita integra*, Stimpson, **1907**, p. 83.

Locality. Station VII. E, 1 ♀ ovig. [67].

Remarks. C.l. 7 mm., C.b. 11 mm.

The ridge which Alcock refers to as running along the distal two-thirds of the outer surface of the larger hand is present in this specimen and is continued along the fixed finger; on the narrower chela a similar ridge is present, and in addition one above it which runs to the gape of the two fingers.

It is the right chela which in the present specimen is the larger.

Subgenus THALAMITOÏDES, *A. Milne-Edwards*, 1869.

Thalamitoïdes has come to be treated as a genus, perhaps by accident rather than by design. I use the name in its original meaning. *See* A. Milne-Edwards, **1869**, p. 146.

25. THALAMITA (THALAMITOÏDES) TRIDENS, *A. M.-Edw.*, 1869, var. SPINIGERA (*Nob.*, 1905). *See* Nobili, **1906**, p. 213.

For the species, *see* A. Milne-Edwards, **1869**, p. 149, pl. 6. figs. 1–7.

Locality. No locality given, 1 ♀ juv. [68].

Remarks C.l. 4 mm.

The specimen shows the characters of var. *spinigera*, the basal joint of the second antenna bearing spines between the outer frontal lobe and the orbit,

and the hands bearing seven spines on the upper border. Of the antennal spines above named there are three on the right antenna, of which the middle one is very small, and four on the left antenna, of which the two at the orbital end are small, particularly the inner of the two.

The line uniting the posterior teeth of the lateral border of the carapace is well marked, and the posterior gastric line is somewhat curved, with the convexity backwards, so that the general appearance of the lines on the carapace is as in A. Milne-Edwards's figure of *T. quadridens* (A. Milne-Edwards, **1869**, pl. 6. fig. 8).

The part of the carapace anterior to the posterior gastric line is seen by the aid of a lens to be closely covered with small low granules.

This appears to be essentially a Red Sea variety, and may perhaps come to be given specific rank.

Genus Podophthalmus, *Lamarck*, 1801.

(Original orthography *Podophtalmus*, not *Podophthalmus*.)

26. Podophthalmus vigil (*Fabricius*, 1798). *See* H. Milne-Edwards, **1834**, p. 467.

Podophthalmus vigil, Nobili, **1906**, p. 213.

Locality. Station IV., 1 ♂ juv. [69].

Remarks. C.l. 7 mm., C.b. including spines 14·5, frontal b. 2·5, lateral epibranchial spine 5, length of post. bord. C. 5, eye-stalk including eye 6·75 mm. The specimen is thus very small, H. Milne-Edwards's specimens were 2 to 4 inches in length.

Both chelipeds are lost, but it appears clear that the specimen comes under the present species, agreeing in other points with H. Milne-Edwards's description (*loc. cit.*) and figure (H. Milne-Edwards, **Cuv.**, pl. 9. fig. 1), except that the two pairs of antennæ are of equal length, instead of the second being much shorter than the first pair.

Family XANTHIDÆ.

Genus Carpilius, *Desmarest*, 1825.

27. Carpilius convexus (*Forskål*, 1775). *See* Alcock, **1898**, p. 80.

Carpilius convexus, Nobili, **1906**, p. 214.
Carpilius convexus, Stimpson, **1907**, p. 37.

Locality. Station VII. A, 1 ♀ [70].

Remarks. C.l. 50 mm.

The pitting of the carapace extends over the whole of the dorsal surface; it is coarse inside the frontal and antero-lateral borders, less so in the middle region, and faint on the posterior slope.

Genus CARPILODES, *Dana*, 1851.

28. CARPILODES LÆVIS, *A. Milne-Edwards*, 1873. *See* Nobili, **1906**, p. 215.
Locality. No locality given, 1 ♀ [71].
Remarks. C.l. 5·25 mm.

Areolæ **1 M** are not separated from the inner parts of the protogastric areolæ (**2 M**) ; Nobili calls attention to the variability which occurs in this respect in the species.

29. CARPILODES RUGATUS (*H. Milne-Edwards*, 1834). *See* Alcock, **1898**, p. 84.

Carpilodes rugatus, Nobili, **1906**, p. 219.

Localities. Station VII. B, 1 ♂ small [72] ; Station IX. B, 1 ♀ ovig. [73].
Remarks. ♀ 73, C.l. 6 mm., C.b. 11 mm.; ♂ 72, C.l. 4·4 mm., C.b. 8 mm.

The specimens agree very closely with the figures of A. Milne-Edwards (A. Milne-Edwards, **1865**, pl. 12. figs. 3–3 *b*).

Genus ATERGATIS, *de Haan,* 1833.

30. ATERGATIS ROSEUS (*Rüppell*, 1830). *See* Alcock, **1898**, p. 97.

Atergatis roseus, Nobili, **1906**, p. 229.

Localities. Station V. E, 1 ♂ [74] ; no locality given, 1 ♀ [75].
Remarks. ♂ 74, C.l. 16 mm.; ♀ 75, C.l. 13 mm.

In the following points the present examples approach *A. integerrimus* (Lamarck) : (*a*) the cardiac region is partly indicated by a pair of short faint curved longitudinal creases placed with convexities facing each other ; (*b*) the dorsal surface of the carapace is irregularly and rather distantly pitted, especially near the frontal and antero-lateral borders ; (*c*) the upper edge of the hand is bluntly and not very conspicuously crested.

The essential reason for placing the specimens under the present species is the absence of any ridge or tooth from the lateral epibranchial angle.

Genus PLATYPODIA, *Bell,* 1835.

=*Lophactæa,* A. M.-Edw., 1865; *see* Rathbun, **1897**, p. 159.

31. PLATYPODIA ANAGLYPTA (*Heller,* 1861). *See* Alcock, **1898**, p. 102.

Lophactæa anaglypta, Alcock, *loc. cit.*
Lophactæa anaglypta, Nobili, **1906**, p. 233.

Localities. Station V. B, 1 ♀ small [76] ; Station V. E, 1 ♂ [77], 3 ♀ [78–80].
Remarks. ♀ 76, C.l. 6 mm., C.b. 9·5 mm. ; ♂ 77, C.l. 9·5 mm. ; ♀ 78, C.l. 11 mm. ; ♀ 79, C.l. 17 mm. ; ♀ 80, C.l. 19 mm. and C.b. 28·5 mm.

The carapace proportions apparently remain much the same during growth. Thus C.b. ÷ C.l. is about 1·5 in both ♀ 76 (C.l. 6 mm.) and ♀ 80 (C.l. 19 mm.).

The front does not present a fissure in any of the specimens.

Genus Zosimus, *Leach*, 1818.

(Original orthography *Zosimus*, not *Zozymus*.)

32. Zosimus æneus (*Linnæus*, 1764). *See* Alcock, **1898**, p. 104.

Zozymus æneus, Nobili, **1906**, p. 235.
Zozymus æneus, Stimpson, **1907**, p. 42.

Locality. Station VII. C, 1 ♂ [81].

Remarks. C.l. 28 mm.

Genus Xantho, *Leach*, 1815.

33. Xantho distinguendus, *de Haan*, 1835. *See* Alcock, **1898**, p. 113.

Xantho distinguendus, Nobili, **1906**, p. 239.
Xantho distinguendus, Laurie, **1906**, p. 401.

Localities. Station I. E, 1 ♂ [82], 2 ♀ [83, 85 ovig.]; a bottle labelled "Trials 1" 1 ♀ ovig. [84].

Remarks. ♂ 82, C.l. 11·75 mm.; ♀ 83, C.l. 7 mm.; ♀ 84, C.l. 7·5 mm.; ♀ 85, C.l. 10 mm.

In specimens 82, 84, and 85 the right, and in specimen 83 the left, chela is the larger.

34. Xantho hydrophilus (*Herbst*, 1790). (Plate **43**. fig. 1.) *See* Alcock, **1898**, p. 118.

Xantho (*Leptodius*) *exaratus*, Alcock, *loc. cit.*
Leptodius exaratus, Nobili, **1906**, p. 240.
Leptodius exaratus, Nobili, **1907**, p. 121.
Xantho (*Leptodius*) *exaratus*, Laurie, **1906**, p. 402.
Chlorodius exaratus, Stimpson, **1907**, p. 52.
Leptodius exaratus, var., Rathbun, **1911**, p. 215.
Xantho hydrophilus, Stebbing, **1910**, p. 297.

Localities. Station V. D, 2 ♀ [86, 87 ovig.]; Station VII. E, 1 ♂ [88].

Remarks. ♂ 88, C.l. 7 mm.; ♀ 87 ovig., C.l. 5 mm.; ♀ 86, C.l. 5 mm.

Under a lens the carapace, chelipeds, and walking-legs are seen in all three specimens to be covered with granules which are obsolescent in some places but well developed in others: thus they are obsolescent on the posterior portions of the dorsal surface of the carapace, but well seen on the anterior and antero-lateral portions, the transverse edges of the areolæ standing out conspicuously; they form a beaded row along the margin of

the front, and a less clear row of beads along the upper margin of the orbit; along the lobes of the antero-lateral borders of the carapace they tend to be dentiform in the two smaller specimens and absent in the larger one; on the rugulæ of the upper part of the outer surface of the hand they are also clearly seen, but they are very obscure on the inner surface of the palm; on the upper margin of the meropodites, carpopodites, and propodites of the walking-legs they are crisp, two rows on the upper border of the dactylopodites being more or less spiniform; there are a few minute spinules on the lower margin of the propodites and dactylopodites; on the lower margin of the dactylopodites, at the base of the terminal light brown horny claw and at right angles to it, is a strongly developed tooth, about a quarter to a third as large as the claw itself. The dactylopodites have thus for *X. hydrophilus* a well-armed aspect (Pl. **43.** fig. 1). The antero-lateral teeth of the carapace are well developed and procurved.

Stimpson gives an interesting list of varieties of this highly variable species, but the present specimens do not fall under any variety described by him. They have somewhat the granulation of his var. *i, granulosus* (*loc. cit.* p. 56, pl. 6. fig. 3), though the spiniform tendency of the granulation of the dactylopodites of the walking-legs is not mentioned by Stimpson, while the granules of the outer surface of its hand appear in his variety to be larger and more conspicuous than in my specimens. The antero-lateral teeth have much the appearance that they have in Stimpson's figure of his var. *h, latus* (*loc. cit.* pl. 6. fig. 9), *i. e.* less triangular than in *granulosus*, and the last two in particular are more tooth-like in form, but their margins do not bear large granules.

The denticulate armature of the walking-legs, and of the dactylopodites in particular, is noteworthy; this and the general tendency to granulation all over the animal are differences from Alcock's description.

Genus Etisus, *H. Milne-Edwards*, 1834.

35. Etisus lævimanus, *Randall*, 1840*. *See* Alcock, **1898**, p. 131.

Etisus lævimanus, Nobili, **1906**, p. 244.
Etisus lævimanus, Rathbun, **1906**, p. 851.
Etisus convexus, Stimpson, **1907**, p. 36, pl. 5. fig. 2.

Locality. No locality given, 1 ♂ [89], 1 ♀ ovig. [90].

Remarks. ♀ ovig. 90, C.l. 17·5 mm., C.b. 25·25 mm., Ch.l. 30 mm.; ♂ 89, C.l. 16 mm., C.b. 23·75 mm., Ch.l. 31 mm., fronto-orbital b. 14·75 mm., frontal b. 7 mm.

It will be noticed that the chelipeds of the ♂ have by no means yet attained their enlarged condition, though the ♀, which is only a little larger, is ovigerous.

In the ♀ specimen the right, and in the ♂ the left, chela is the more massive.

* For date see p. 425.

Genus ACTÆA, *de Haan*, 1833.

36. ACTÆA TOMENTOSA (*H. Milne-Edwards*, 1834). *See* Alcock, **1898**, p. 140.

Actæa tomentosa, Nobili, **1906**, p. 252.
Acteodes tomentosus, Stimpson, **1907**, p. 44.

Locality. Station VII. C, 1 ♀ non-ovig., but apparently adult [91].
Remarks. C.l. 16 mm., C.b. 24·75 mm., C.l.÷C.b.=·65.

37. ACTÆA HIRSUTISSIMA (*Rüppell*, 1830). *See* Alcock, **1898**, p. 141.

Actæa hirsutissima, Nobili, **1906**, p. 252.

Localities. Station V. A, 8 small [92–99]; Station V. B, 1 ♂ [100], 1 ♀ small [101]; Station V. C, 1 ♀ small [102]; Station V. E, 2 ♂ [103–104]; no locality given, 1 ♂ [105].

Remarks. The largest ♂ has C.l. 15 mm. and C.b. 23·5 mm., so that C.l.÷C.b.=·64; C.l. of smallest specimen 3 mm.

38. ACTÆA GARRETTI, *Rathbun*, 1906. *See* Rathbun, **1906**, p. 852, pl. 9. fig. 8.

Actæa garretti, Rathbun, **1911**, p. 218.
Actæa rufopunctata, var. *retusa*, Nobili, **1906**, p. 253.

Locality. Station IX. A, 1 ♂ [106], 1 ♀ [107].
Remarks. ♂ 106, C.l. 8 mm., C.b. 11·5 mm., C.l.÷C.b.=·69; ♀ 107, C.l. 7 mm., C.b. 10·75 mm., C.l.÷C.b.=·66.

39. ACTÆA POLYACANTHA (*Heller*, 1861). *See* Heller, **1861**, p. 339, pl. 3. fig. 21.

Chlorodius polyacanthus, Heller, *loc. cit.*
Actæa polyacantha, Nobili, **1906**, p. 259.
Actæa polyacantha, Rathbun, **1911**, p. 222.

Localities. Station V. A, 1 ♀ [108]; Station VII. D, 1 ♀ non-ovig., but apparently adult [109].

Remarks. ♀ 109, C.l. 7 mm., C.b. 10 mm., C.l.÷C.b.=·7; ♀ 108, C.l. 3·75 mm., C.b. 5·25 mm., C.l.÷C.b.=·68.

This species is evidently allied very closely indeed to the Australian species *peronii* of H. Milne-Edwards (Alcock, **1898**, p. 150) and its Indian variety *squamosa* of Henderson (Henderson, **1893**, p. 357, and Laurie, **1906**, p. 404). Alcock suggests with a query that the two species may be synonymous. I have not sufficient new material before me to warrant in my opinion their union as yet. Rathbun keeps them apart and calls attention to the intermediate position occupied by *A. polyacantha* between *peronii*, H. M.-Edw., and *spinosissima*, Borradaile.

40. ACTÆA GRANULATA (*Audouin et Savigny*, 1826). *See* Alcock, **1898**, p. 151.

Actæa granulata, Nobili, **1906**, p. 261.
Actæa granulata, Nobili, **1907**, p. 127.
Actæa pura, Stimpson, **1907**, p. 44, pl. 5. fig. 7.
Actæa granulata, Stebbing, **1905** (**1**), p. 30.

Localities. Station I. B, 2 ♂ [110, 111]; Station I. E, 1 ♂ small [112], 1 ♀ small [113]; Station I. J, 1 ♂ [114] 1 ♀ [115]; Station I. L, 1 ♂ [116]; no locality given, 1 ♂ [117], 4 ♀ [118, 119, 120, 121 ovig.].

Remarks. ♂ juv. 113, C.l. 6·2 mm.; ♂ 110, C.l. 21 mm.; ♀ juv. 112, C.l. 4 mm.; ♀ ovig. 121, C.l. 15·5 mm.

41. ACTÆA FOSSULATA (*Girard*, 1859). *See* Alcock, **1898**, p. 148.

Actæa fossulata, Nobili, **1906**, p. 262.
Actæa fossulata, Nobili, **1907**, p. 126.

Localities. Station V. C, 1 ♂ [122]; Station VII. B, 1 ♂ [123]; Station VII. D, 1 ♂ [124], 1 ♀ [125]; Station VII. E, 1 ♂ [126].

Remarks.

	125 ♀.	123 ♂.	122 ♂.	124 ♂.	126 ♂.
C.l.	3 5	3·1	3·25	6·0	7·75 mm.
C.b.	5·25	4·75	5·0	9·0	12·0 mm.
C.l.÷C.b.....	·66	·65	·65	·66	·65

No growth-change in the ratio is indicated by the above measurements.

Genus CHLORODIELLA, *Rathbun*, 1897.

= *Chlorodius*, H. M.-Edw., 1834, not Leach, 1823, which latter = *Atelecyclus*, Leach, 1814; *see* Rathbun, **1897**, p. 157.

42. CHLORODIELLA NIGER (*Forskål*, 1775). *See* Alcock, **1898**, p. 160.

Chlorodius niger, Alcock, *loc. cit.*
Chlorodius niger, Nobili, **1906**, p. 262.
Chlorodius niger, Nobili, **1907**, p. 128.
Chlorodius niger, Stimpson, **1907**, p. 50.
Chlorodiella [= *Chlorodius*] *niger*, Laurie, **1906**, p. 405.
Chlorodiella niger, Rathbun, **1906**, p. 857 (synonymy).

Localities. Station I. J, 2 ♀ [154, 166]; Station V. A, 3 ♂ [132, 133, 142], 2 ♀ [129, 130]; Station V. E, 6 ♂ [147, 153, 160–163], 2 ♀ [143, 146]; Station VII. D, 7 ♂ [134, 138, 144, 148, 156, 157, 164], 10 ♀ [127, 128, 135, 139, 140, 141, 145, 150, 151, 152]; no locality given, 3 ♂ [131, 158, 165], 5 ♀ [136, 137, 149, 155, 159].

Remarks. The above include 40 specimens, and as their range of size is considerable, I take the opportunity which so large a series affords of making a study of growth-change in regard to certain variable characters. Three characters are selected and their conditions set forth in the following table, which includes also the size and sex and a statement as to which is the larger cheliped:—

No. of specimen.	Sex.	C.l.	Number of lobes of ant.-lat. bord. C. which end in procurved spine-like points.	Condition of tubercle or spine on anterior margin of arm.	Armature of posterior margin of arm.	Larger chela.
127.	♀	3·5 mm.	3	Spine.	Spiniform.	Left.
128.	♀	3·7 mm.	3	,,	,,	Right.
129.	♀	3·7 mm.	3	,,	,,	Left.
130.	♀	4·0 mm.	3	,,	,,	Right.
131.	♂	4·0 mm.	3	,,	,,	Right.
132.	♂	4·5 mm.	3	,,	,,	Right.
133.	♂	4·5 mm.	3	,,	,,	Left.
134.	♂	5·0 mm.	3	,,	,,	Right.
135.	♀	5·0 mm.	3	,,	,,	Left.
136.	♀	5·0 mm.	3	,,	,,	Left.
137.	♀	6·0 mm.	3	,,	,,	Right.
138.	♂	6·0 mm.	3	,,	,,	Right.
139.	♀	6·0 mm.	3	,,	,,	Left.
140.	♀ ovig.	6·0 mm.	3	,,	Granular.	Right.
141.	♀ ovig.	6·0 mm.	2	,,	,,	Right.
142.	♂	6·5 mm.	3	,,	Spiniform.	Left.
143.	♀	6·5 mm.	3	,,	Granular.	Right.
144.	♀	6·5 mm.	2	,,	,,	Left.
145.	♂	6·7 mm.	3	,,	,,	Right.
146.	♀	7·0 mm.	3	,,	,,	Left.
147.	♂	7·2 mm.	2	,,	,,	Left.
148.	♂	7·5 mm.	3	,,	,,	Left.
149.	♂	7·5 mm.	2	,,	,,	Left.
150.	♀ ovig.	7·7 mm.	2	,,	,,	Right.
151.	♀	8·0 mm.	3	,,	,,	Left.
152.	♀ ovig.	8·0 mm.	2	,,	,,	Left.
153.	♂	8·0 mm.	2	,,	,,	Right.
154.	♀	8·0 mm.	2	,,	,,	Left.
155.	♀	8·0 mm.	2	,,	,,	Left.
156.	♂	9·0 mm.	2	,,	,,	Right.
157.	♂	9·0 mm.	2	Small tubercle.	,,	Left.
158.	♂	9·0 mm.	3	Spine.	,,	Right.
159.	♀	9·0 mm.	1	Tubercle.	,,	Left.
160.	♂	9·5 mm.	2	Pointed tubercle.	,,	Right.
161.	♂	9·5 mm.	0	Small tubercle.	,,	Right.
162.	♂	10·0 mm.	1	Tubercle.	,,	Right.
163.	♂	11·0 mm.	0	Small tubercle.	,,	Right.
164.	♂	11·0 mm.	1	Small tubercle.	,,	Left.
165.	♂	11·5 mm.	0	Tubercle.	,,	Left.
166.	♀	12·0 mm.	0	Tubercle.	,,	Left.

It will be noticed that, as a rule, crabs with C.l. from 3·5 to 6·5 mm. have the last three of the antero-lateral lobes spiniform, those with C.l. 7 to 9 mm. have the last two lobes spiniform, those with C.l. 9·5 to 11 mm. tend to have only the last lobe spiniform, and that in those with C.l. above 11 mm. there is an absence of the spiniform condition in all the lobes.

It will be further noted that the above is only an average relation and that variability is not the same in crabs of all sizes. Thus, where C.l. is 3·5 to

6 mm., variability is practically nil, whereas variability is high in crabs with C.l. from 9 to 11 mm.

The spiniform character of the tooth on the anterior edge of the arm gives place to the tubercular condition in crabs whose C.l. has reached about 9 mm.

The spiniform armature of the posterior edge of the arm becomes granular when the C.l. reaches about 6 mm.

Another point to be noted is that ovigerous females occur with C.l. of only 6 mm. and that the different conditions of the characters above described are thus related with size rather than with sexual maturity ; this is quite usual among crabs. On the other hand, the same ovigerous specimens have the broadened form of abdomen, an example of a character associated with sexual maturity rather than with size.

The number of individuals in which the right or left hand respectively is the larger is approximately equal, thus the right is larger in 19 and left in 21 individuals.

Some notes on the high variability of this species are given by A. Milne-Edwards (**1873** (**1**), p. 214).

42 *a*. CHLORODIELLA NIGER, var. CYTHEREA (*Dana*, 1852). *See* Dana, **1852**, p. 213, pl. 12. figs. 2 *a–c*.

Chlorodius cytherea, Dana, *loc. cit.*
Chlorodius cytherea, Stimpson, **1907**, p. 50.

Localities. Station V. G, 1 ♂ juv. [167], 5 ♀ juv. [168–172] ; Station IX. A, 4 ♂ [173–176], 2 ♀ ovig. [177, 178].

Remarks. C. l. ranges in the ♀ specimens from 2 to 4·5 mm. and in the ♂ from 3 to 5·25 mm. In the largest ♂ (176) C.b. is 8·25 mm. and C.b.÷C.l.=1·57.

The length of the larger cheliped is related to the carapace length as follows :—

	177 ♀ ovig.	178 ♀ ovig.	173 ♂.	174 ♂.	175 ♂.	176 ♂.
C.l.	4·0	4·5	4·0	4·75	5·0	5·25 mm.
Ch.l.	7·75	8·75	8·0	9·75	12·0	11·25 mm.
Ch.l.÷C.l.	1·94	1·94	2·00	2·05	2·40	2·10
Larger Ch.	Right	Right	Left	Left	Right	Left

C. cytherea (Dana) is included by Alcock (Alcock, **1898**, p. 160) as a synonym of *C. niger*. It appears possible that it may come to be re-elevated to specific rank, but I have not sufficient data to warrant my taking this step.

Var. *cytherea* has not hitherto been recorded from the Red Sea.

Genus PHYMODIUS, *A. Milne-Edwards*, 1863.

43. PHYMODIUS UNGULATUS (*H. Milne-Edwards*, 1834). *See* Alcock, **1898**, p. 162.

Phymodius ungulatus, Nobili, **1906**, p. 264.
Phymodius ungulatus, Nobili, **1907**, p. 129.
Phymodius ungulatus, Rathbun, **1906**, p. 857.
Phymodius ungulatus, Borradaile, **1902 (2)**, p. 259.
Phymodius monticulosus, Alcock, **1898**, p. 163.
Phymodius monticulosus, Nobili, **1906**, p. 264.
Phymodius obscurus, Rathbun, **1906**, p. 858.

Locality. Station VII. D, 10 ♂ [179–188], 6 ♀ (1 ovig.) [189–194].

Remarks. ♂ C.l. varies from 4·25 to 6·5 mm.; ♀ ovig. C.l. 5 mm.

In five of the males the right, and in five the left, chela is the larger.

The specimens fall under Alcock's description of *P. ungulatus.*

Regarding the inclusion of *P. obscurus* (Lucas) (=*P. monticulosus* (Dana)) under *P. ungulatus*, see Borradaile, *loc. cit.*, but also Nobili, **1906**, *loc. cit.*

44. PHYMODIUS SCULPTUS (*A. Milne-Edwards,* 1873). *See* Alcock, **1898**, p. 164.

Phymodius sculptus, Nobili, **1906**, p. 265.

Localities. Station VII. B, 1 ♂ [195]; Station IX. A, 2 ♂ [196, 197], 5 ♀ [198–202].

Remarks. The specimens show growth-change in regard to the condition of the antero-lateral lobes. In the two smallest specimens, ♀ 198 (C.l. 3·9 mm.) and ♀ 199 (C.l. 4·3 mm.), all four lobes are produced into procurved spines; in ♀ 200 (C.l. 4·7 mm.) the three most posterior lobes are produced into procurved spines; and in all the remaining five specimens with C.l. ranging from 7 to 9·25 mm. the last two only of the lobes are so produced. C.l. of these last five specimens is as follows:—♀ 7 mm.; ♀ 7·5 mm.; ♂ 8·25 mm.; ♂ 9 mm.; ♂ 195, 9·25 mm.

In ♂ 195 the right, and in the other two ♂ specimens the left, chela is the larger.

Genus CHLORODOPSIS, *A. Milne-Edwards*, 1873.

45. CHLORODOPSIS ARABICA, n. sp. (Plate **42**. figs. 1–1 *b*; Pl. **43**. figs. 2, 4 *a*–4 *d*.)

Localities. Station V. E, 3 ♂ [203–205]; Station VI. 1 ♂ [212]; Station X. 1 ♂ [206], 4 ♀ [207–210]; no locality given, Crossland's label reads "A part of the fauna of two dead valves of *M. margaritifera* which were covered by sponges etc. and supported a regular microcosmos of life," 1 ♀ adult non-ovig. [211].

Description of ♂ 203.—The entire carapace is cut into distinct areolæ, isolated by broad fairly deep channels. All the areolæ are granulated: those

of the posterior half are closely covered with small rounded granules (smaller and more numerous than in *C. areolata* (H. M.-Edw.)). The areolæ of the anterior half of the carapace have a more lumpy surface, they are more prominent and end more abruptly in their anterior portions, but slope off gradually posteriorly, and the granules covering them have also their more prominent part directed anteriorly and the dorsal surface planed off, as it were, posteriorly, so as to slope gradually backwards; the granules also are more irregular in size on the anterior part of the carapace, larger ones tending to cluster at the anterior margins of the areolæ, as may be well seen, for example, in 2 F, where an appearance is produced which contrasts markedly with the rounded character of the same areolæ in *C. areolata.* The dividing channels are naked; they are smooth in front of the cervical groove, but tend to be obscurely granular behind this. There is no hair on the dorsal surface of the carapace, except a bristle or two here and there.

The front is distinctly and broadly cut by a **U**-shaped notch into two lobes, the outer angle of each of which forms a separate lobule. The free margin of the large inner frontal lobes bears a neat row of bead-like granules.

The three fissures of the granular orbital margin are well marked, giving a lobed appearance.

The antero-lateral border is divided into four rounded-triangular lobes, in addition to the outer orbital angle, of which the third is the most prominent. The greatest breadth of the carapace is therefore across this region.

All the areolæ of Dana's scheme are clearly visible and some of them are further subdivided : 2 M is divided by a longitudinal groove into a smaller inner and a larger outer portion, 6 L is subdivided into two, the tooth S is distinct from the areola 1 R, 2 R is divided into two ; the narrow median anterior process of 3 M runs forward between the posterior portions of the inner borders of 2 M, 1 P is shaped as in *C. areolata,* having a median notch anteriorly, corresponding with the median posterior projection.

The epistome is smooth, the sub-hepatic and sub-branchial regions are granulated, as also the sternum between the chelæ ; granulation becomes obscure and pitting mingles with it on the sterna between the walking-legs. All these regions are naked or practically so.

There is an inconspicuous granulated sub-hepatic tubercle.

The outer distal angle of the basal antennal joint is drawn out into the large orbital hiatus, so as to lie against the inner angle of the lower orbital margin, but it falls very far short of filling the hiatus; the inner distal angle falls short of the hiatus and slopes obliquely where it comes in contact with the turned-down outer frontal lobe. The antennal flagellum arises from the basal joint where the latter makes an angle with the outer frontal lobe, and so lies in the hiatus.

The exposed surface of the external maxillipedes is naked, but the inner margin of the ischium has a short fringe of delicate hairs, very different from

the stout fringe in *C. areolata*. The merus is granular; it has a prominent rounded, somewhat upturned antero-external angle; its anterior margin is notched, as also is its antero-internal angle, proximal to the latter notch is a smooth-floored depression. The ischium has a slight granulation anteriorly and slight pitting posteriorly; it has a longitudinal groove to the inner side of the middle line.

Chelipeds subequal in length, a little less than twice the length of the carapace, but one (left) chela is considerably the more massive. The whole surface of the chelipeds, including the larger rounded tubercles of the exposed surface of the wrist (2 tubercles mark the inner angle) and the tubercles of the upper border of the hand, is granulated. On the outer surface of the hand the tubercles become smaller, particularly on the lower part of the tuberculated area, and smooth, and tend to run in 4 longitudinal rows, of which the 3rd, counting from above, runs along the middle and is much the best defined, and the 4th runs on to the proximal portion of the fixed finger. The fingers are well arched, the apposed borders not meeting except at their cup-shaped tips, and each armed with three teeth. The arrangement of these teeth is the same in the two chelæ, but their relative proportions differ a good deal. In both chelæ those of the movable finger are equidistant, while the distal tooth of the fixed finger is well removed from the other two and faces the large gap distal to the third tooth of the dactylus. In the smaller chela these teeth are of approximately equal size and not particularly large, but in the larger chela the 1st and 3rd of the dactylus and the 2nd of the fixed finger are enlarged. Each dactylus has a few granules on its upper margin proximally, also a pitted groove on its upper margin, and both dactylus and fixed finger have two pitted grooves on the outer surface.

Chelipeds in ♀ (specimen 211) are little more than one-half as long again as the carapace. They are less massive than in the ♂, subequal and very similar. The fingers are less strongly arched than in the ♂, but, as in the ♂, they only meet at their hollowed tips. The teeth of the fingers are not enlarged except the middle one of the fixed finger, and this by no means to the same extent as in the ♂. The armature is sharper, the granules of the tubercles of the wrist and upper border of the hand are crisp, the two tubercles of the inner angle of the wrist are spiniform and curved, the smooth tubercles of the outer surface of the hand are conical and pointed; on the same surface of the hand the tubercles extend almost to the ventral margin. Some of the above differences may be due to the smaller size of the ♀ specimen described as compared with the described ♂; it has, however, though non-ovigerous, the well-fringed broad abdomen, which may be taken to indicate sexual maturity.

The dorsal margin of the walking-legs, the ventral margin of their last two joints, and to a less extent the posterior surface of their last three joints bear

fairly long scattered setæ, which do not, however, hide the armature beneath them. The lower and posterior surfaces of the meropodite are granular, the anterior surface is smooth, the upper border bears a row of about seven long sharp teeth. The carpopodite has a double row of teeth on its dorsal border and a third row on the upper part of the posterior surface. The anterior and posterior rows of teeth are continued along the propodite, the posterior one being brought up to a higher level; the middle row is continued halfway along the propodite in the 1st, not so far in the 2nd, a single tooth in the 3rd, and not at all in the 4th walking-leg. The teeth are continued along the upper edge of the dactylopodite. There are a few small teeth distally on the lower border of the meropodite, a single distally directed sharp tooth on the distal end of the lower border of the propodite, and two rows of small teeth on the lower border of the dactylopodite, terminating in a pair of larger ones at the base of the brown claw.

The abdominal terga are in both sexes smooth for the most part, with a few setæ along the lines of articulation of the segments. The margin of the abdomen is fringed inconspicuously with short setæ in the ♂, and in the ♀ with conspicuous long setæ. The abdomen is 7-segmented in the ♀ and 5-segmented in the ♂.

Colours in spirit whitish, with the anterior portion of the carapace and the meri and carpi of the chelipeds a faint orange-red, the same colour much deeper on the hands and also on the exposed surface of the external maxillipedes; fingers chocolate-brown with white tips, the colour of the fixed finger extends a short but quite evident distance along the lower border and both surfaces of the hands.

Remarks. The smaller specimens differ from the larger ones as follows :—

(1) The armature is sharper : thus the granulation of the carapace and chelipeds is crisp, and the tubercles of the chelipeds are dentiform, the two at the inner angle of the wrist in particular are stout curved spines.

(2) The areolæ are less distinct.

(3) The antero-lateral lobes tend to be spiniform and procurved (see Table, p. 454).

(4) In the young ♂ the chelæ show less differentiation from each other and from the ♀ type, and in the young ♀ the abdomen is fringed with short inconspicuous setæ only.

Apart from the above changes, associated with growth, there appears to be considerable variation in the distinctness of the granulation and areolation of the carapace, this being most pronounced in specimens 206 and 212.

The following table illustrates certain growth-changes, together with some characters of the genus *Chlorodopsis*, and also shows that either cheliped may be the larger in the present species :—

	♀ 210.	♀ 209.	♀ 207.	♀ 208.	♀ 211.	♂ 212.	♂ 205.	♂ 203.	♂ 206.	♂ 204.
C.l.	5·0	6·1	7·0	7·0	7·5	6·75	6·75	8·50	9·0	9·25
C.b.	6·9	8·5	9·75	10·0	10·75	9·75	10·0	12·75	14·0	13·75
Fronto-orbital b.	5·0	6·0	6·75	6·75	7·25	6·75	6·75	8·5	8·75	9·0
Frontal b.	2·5	3·0	3·4	3·4	3·75	3·25	3·25	4·25	4·25	4·5
Major diameter orbit ..	1·0	1·2	1·5	1·5	1·75	1·5	1·5	2·0	2·0	2·0
Ch.l. (larger)	7·5	9·75	10·75	10·75	11·5	11·4	..	17·0	..	17·75
Ch.l. (smaller)	7·5	9·75	10·75	10·75	11·5	11·0	..	16·25	..	..
Lower bord. propus (larger)	4·0	5·1	5·75	5·75	6·5	6·1	..	9·5	..	10·0
Lower bord. propus (smaller)	4·0	5·1	5·75	5·75	6·5	5·8	..	9·0	..	..
Propus h. (larger)	1·5	1·9	2·0	2·0	2·3	2·8	..	4·25	..	4·25
Propus h. (smaller)	1·5	1·9	2·0	2·0	2·3	2·25	..	3·25	..	..
Fronto-orb. b. ÷ C.b.	·72	·71	·69	·67	·67	·69	·67	·66	·62	·65
Frontal b. ÷ C.b.	·36	·35	·35	·34	·35	·33	·32	·33	·30	·33
Ch.l. (larger) ÷ C.b.	1·50	1·60	1·54	1·54	1·53	1·69	..	2·00	..	1·92
Number of side-lobes, counting from behind, which are spiniform .	3	3	3	4	1	1 on left	2	0	1	1
Condition of the two prominences on inner angle of wrist	Spines	Spines	Spines	Spines	Spines	Blunt tubercles	Teeth	Blunt tubercles	..	Blunt tubercles
Larger cheliped	Left	Right	Left	Left	Right	Left	Left	Left	...	Left

The new species has affinities with several other species of *Chlorodopsis*. From *C. areolata* it can be distinguished (*a*) by the type of granulation of the carapace and more particularly of the anterior half, for *C. areolata* has a regular covering of larger pearly granules which are rounded and of similar size in anterior and posterior regions alike ; (*b*) by the absence of the coat of very short fur from dorsal and ventral surfaces of the carapace and from the exposed surface of the external maxillipedes, chelipeds, and walking-legs ; (*c*) by the scattered arrangement of the less numerous long setæ fringing the walking-legs, not hiding the dorsal armature of the latter—this contrasts with the dense close fringe in *C. areolata* ; (*d*) by a few differences in the areolation, thus the areolæ 2 F have a much more irregular appearance than in *C. areolata*, where they are rounded and evenly granular ; the anterior narrow portion of 3 M extends forward between the posterior borders of the pair 2 F ; 3 M has less tendency to be tripartite ; (*e*) by the wider orbital hiatus and less extent to which it is filled by the basal joint of the antenna ; (*f*) by the armature of the dorsal margin of the three distal joints of the walking-legs, which makes some approach to that of *C. spinipes*—that of *C. areolata* is hidden by the fringe of setæ, and when the latter is removed is found to be reduced to a granulation in carpopodite and propodite, and entirely absent from dorsal edge of dactylopodite.

The new species may be distinguished from *C. spinipes* and *C. wood-masoni* (*a*) by the continuation of the areolation over the posterior portion of the

carapace, though here the grooves between the areolæ are shallower than in the anterior part; (*b*) by the longitudinal division of areolæ 2 M; (*c*) by the less spiniform character of the armature on the antero-lateral regions of the carapace and the frontal margin; (*d*) the tubercles of the chelipeds are not spiniform as in *C. spinipes*, but are much as in Alcock's figure (Alcock, **1899** (**3**), Pl. 37. fig. 7) of *C. wood-masoni*, though less numerous on the larger hand; (*e*) the hands of the ♀ are subequal in *C. arabica* and the tubercles of their outer surfaces arranged in more definitely separated straight lines (see figs.); (*f*) the armature of the dorsal margin of the carpopodite and propodite of the walking-legs is less spiniform than in *C. spinipes* (Pl. **43**. figs. 3 *a*–3 *d*), more as in Alcock's figure of *C. wood-masoni*. It will be noted that in (*d*) and (*f*) *C. wood-masoni* differs from *C. spinipes* in the direction of the new species. Characters in which the new species approaches *C. spinipes* and *C. wood-masoni* include the type of granulation of the anterior portion of the carapace, the arrangement of the setæ of the walking-legs, and the almost naked character of the carapace.

An interesting character in all species of *Chlorodopsis* is the form and relation of the basal antennal joint. In this, which has been described above, the new species differs a good deal from both *C. areolata* and *C. spinipes* (A. Milne-Edwards, **1873** (**1**), pl. 8. figs. 8 & 6 *a*), and has much the same appearance as in three specimens of *C. pilumnoides* from Ceylon which I have before me (recorded by Laurie, **1906**, p. 406).

The new species falls under section I. of Alcock's key to the Indian species of *Chlorodopsis* (Alcock, **1898**, p. 165), becoming thus associated with *C. areolata*, from which it is distinguished as above.

Type specimens are in the British Museum.

46. Chlorodopsis spinipes (*Heller*, 1861). (Plate **43**. figs. 3 *a*–3 *d*.) *See* Alcock, **1898**, p. 169.

> *Chlorodopsis spinipes*, Nobili, **1906**, p. 270.
> ? *Chlorodopsis wood-masoni*, Alcock, **1898**, p. 170, and **1899** (**3**), pl. 37. fig. 7.

Localities. Station V. B, 2 ♂ [213, 214], 1 ♀ [215]; Station V. C, 1 ♂ [216], 2 ♀ [217, 218]; Station V. D, 5 ♂ [219–223], 1 ♀ [224]; Station V. E, 1 ♀ [225]; Station VII. D, 1 ♀ [226].

Remarks. Except as regards the denticulation of the frontal margin, all the specimens fall fairly well under Alcock's description of *C. spinipes*.

One may note in particular:—

(*a*) In all cases the first tooth of the antero-lateral border of the carapace is much reduced as compared with those following it. This is the case in *C. spinipes*.

(*b*) In one example, specimen 226, there is a minute spinule about half-way along the posterior border of the second antero-lateral spine of each side; this is absent in the other examples, where the condition is as in *C. spinipes*.

(*c*) The spines on the walking-legs are more pronounced than in Alcock's figure of *C. wood-masoni.*

(*d*) The armature of the wrist and hand is markedly acicular, giving an appearance very different from the tubercles figured by Alcock for *C. wood-masoni*; in the case, however, of the ovigerous female, specimen 218, the condition of the right cheliped makes a decided approach to Alcock's figure just named.

So far then the present specimens fall without doubt under *C. spinipes* in spite of (*b*) and (*d*) above, but they agree with *C. wood-masoni* in the denticulate character of the frontal margin. In this latter character they differ a good deal among themselves, but Alcock's figure of *C. wood-masoni* gives a very fair idea of the frontal condition in some of them. It appears doubtful whether Heller's figure of *C. spinipes* is intended to convey any different impression.

The following is the condition in each of the present specimens :—

No. of specimen.	Sex.	C.l.	Number of denticles on left inner lobe of front.	Number of denticles on right inner lobe of front.	Enlarged denticles of inner frontal lobes; the numbers are from inner end. (Outermost denticles excluded.)
		mm.			
219.	♂	3·25	23	23	2nd, 3rd, 4th, and 5th on each lobe (1st is small on right and very small on left).
220.	♂	3·25	22	22	2nd, 3rd, and 4th on right. 1st, 2nd, and 3rd on left.
224.	♀	3·75	4+?+5	6+?+5	2nd and 3rd on each. (Denticles obsolescent on middle of each lobe.)
215.	♀ ovig.	4·25	17	17	1st, 2nd, and 3rd on each.
221.	♂	4·5	14	13	None enlarged.
217.	♀	5·0	16	16	2nd and 3rd on right. 2nd, 3rd, and 4th on left.
218.	♀ ovig.	5·0	12	12	1st on each.
216.	♂	5·0	11	11	1st on each.
222.	♂	5·25	16	14	2nd and 3rd on right. 2nd, 3rd, and 4th on left.
223.	♂	5·5	18	18	2nd and 3rd on each.
213.	♂	5·5	13	13	1st and 2nd on each.
225.	♀	6·25	8	10	1st, 2nd, 5th, and 7th on right. All on left.
226.	♀	6·25	6	7	All.
214.	♂	7·0	8	11	All, particularly 1st on each.

The outermost tooth of the inner frontal lobe, and in some cases more than one tooth in this position, is also enlarged. There is a similarly enlarged tooth on the small outer frontal lobe to the inner side of the much larger terminal tooth.

It will be noted that the number of teeth is very variable. The larger teeth are of an order of size easily made out under a hand lens which magnifies 6 diameters.

To sum up :—The specimens fall under *C. spinipes*. *C. wood-masoni* has, however, a frontal condition difficult to distinguish from that of *C. spinipes*. The presence of the minute accessory spinule in specimen 226 and the character of the right chela in specimen 218 should be noted as some approach to *C. wood-masoni*. One could hardly perhaps unite the two species on the data supplied by the present specimens, but on the other hand Nobili's remark is to be kept in mind to the effect that examples examined by him throw grave doubt upon their specific distinction.

Genus Cymo, *de Haan*, 1833.

47. Cymo andreossyi (*Audouin et Savigny*, 1826). *See* Alcock, **1898**, p. 173.

> *Cymo Andreossyi*, Nobili, **1906**, p. 271.
> *Cymo Andreossyi*, Nobili, **1907**, p. 129.
> *Cymo andreossyi*, Laurie, **1906**, p. 406. (A single specimen, which belongs to var. *melanodactylus*.)
> *Cymo andreossyi*, Stimpson, **1907**, p. 60.

Localities. Station I. J, 1 ♂ [227] ; Station V. E, 1 ♂ [228], 3 ♀ [229–231]; Station VIII. D, 4 ♂ [232–235], 2 ♀ [236, 237].

Remarks. ♂ 227 is apparently adult, C.l. 18 mm., C.b. 19 mm.; all the others are small, C.l. from 3·25 to 6 mm.

The small ♀ specimens 229 and 236, with C.l. 6 and 5·5 mm. respectively, though not ovigerous, appear to be adult, whereas another specimen with C.l. only 4 mm. is immature.

The frontal breadth of the large specimens agrees with Alcock's description, " $\frac{2}{5}$ the greatest breadth of the carapace," if it be taken to include the inner supraorbital angles ; but if the latter be excluded then the front is only ·33 the greatest breadth of the carapace.

In all the specimens the granules lose their sharpish character on the lower part of the outer surface of the larger hand, becoming here more rounded and pearl-like.

In the large specimen 227 the granules on the upper part of the outer surface of the wrist and hand are sharpish conical; in the other and smaller specimens the granules in this position are sharper, and in some specimens some of them are almost spines.

The aıeolation of the carapace is less clearly seen in the small specimens.

The present examples do not include any having the brown fingers of var. *melanodactylus*, de Haan, which variety is, however, also recorded from the Red Sea. For the synonomy of var. *melanodactylus*, see Alcock, **1898**, p. 174 ;

later records have been made by Nobili, **1906**, p. 271, and Nobili, **1907**, p. 129; see also *Cymo melanodactylus*, Stimpson, **1907**, p. 59. I take this opportunity of pointing out that the specimen recorded from Ceylon by Laurie, **1906**, p. 406, under the name of *Cymo andreossyi* also belongs to var. *melanodactylus*.

Nobili found transitional conditions of finger-coloration both in Red Sea specimens and in examples from the Persian Gulf.

Genus Pilumnus, *Leach*, 1815.

48. Pilumnus propinquus, *Nobili*, 1905. *See* Nobili, **1907**, p. 140.

Pilumnus propinquus, Nobili, **1906**, p. 277, pl. 9. fig. 7.

Localities. Station VII. B, 2 ♂ [238, 239], 2 ♀ [240, 241]; Station X., 1 ♂ [242], 2 ♀ [243, 244]; no locality given, 1 ♂ [245].

Remarks. ♂ C.ls. are 5, 6, 6·75, and 8·75 mm. respectively; ♀ C.ls. 4·5, 4·75, 5·25, and 6 mm. respectively. The largest ♂ (245) has C.b. 12 mm., so that C.b.÷C.l.=1·37; frontal b. of same specimen 3·75 mm. without the inner orbital angles and 5 mm. if the latter be included; distance between outer orbital angles 8·75 mm. These measurements agree very well with those of the specimen described by Nobili.

In the present specimens the armature of the chelipeds and walking-legs is less emphasized than in Nobili's description of forms from the Persian Gulf: thus (*a*) they have in general on the meropodites of the walking-legs only the distal spine of the upper border and this is in a few instances replaced by a blunt tubercle; Nobili calls attention to the variation in the degree of spininess of the meropodites in his forms from the Persian Gulf and notes that the meropodites were without spines in his Red Sea (Djibouti) examples; (*b*) the tubercles of the wrist and upper part of the outer surface of the hand are as a whole conical and pointed; some of them, indeed, more particularly on the smaller hand, are elongated, but very few, and in some specimens none, could be called spiniform; (*c*) in all the subhepatic tooth is present, but it tends to be tubercular rather than spiniform; (*d*) none of the spines is blackish.

In all except the ♀ 241 it is the right hand which is the more massive.

Genus Actumnus, *Dana*, 1851.

49. Actumnus setifer (*de Haan*, 1835), var. tomentosus, *Dana*, 1852. *See* Alcock, **1898**, p. 202.

Actumnus setifer, var. *tomentosus*, Laurie, **1906**, p. 408.
Actumnus tomentosus, Alcock, *loc. cit.*
Actumnus tomentosus, Nobili, **1907**, p. 132.

Localities. Station V. D, 1 ♂ [246], 4 ♀ [247–250]; Station VII. B, 1 ♀ [251]; Station X., 1 ♀ [252]; no locality given, labelled "Trials I.," 2 ♀

[253, 254]; no locality given, labelled "Sponge Inhabiters, 11 Jan., 1905," 1 ♀ [255].

Remarks. The only ♂ in the above series has C.l. 5·75 mm. Specimens 249, 251, and 252, though all ovigerous, are of very different size, C.l. 4, 6, and 11 mm. respectively. Specimens 255, 254, and 253 are not ovigerous, but apparently adult, C.l. respectively 7·5, 8, and 8·5 mm.

♀ 250 and ♀ 254 have each a parasitic *Sacculina* attached to the abdomen, C.l. 4·5 and 8 mm. respectively.

Regarding the position of *tomentosus* as a variety of *A. setifer*, see Miers, **1884**, p. 225, and Laurie, *loc. cit.*

A. setifer has not been hitherto recorded from the Red Sea.

50. Actumnus bonnieri, *Nobili*, 1905. *See* Nobili, **1907**, p. 132, pl. 6. fig. 32.

> *Actumnus Bonnieri*, Nobili, *loc. cit.*
> *Actumnus Bonnieri*, Nobili, **1906**, p. 285.
> *Actumnus bonnieri*, Laurie, **1906**, p. 409.
> *Actumnus bonnieri*, Rathbun, **1911**, p. 232.

Localities. Station VIII. C, 1 ♂ [256] ; Station X., 1 ♀ ovig. [257].

Remarks. ♀ ovig. 257 has C.l. 9·25 mm. ; ♂ 256 has C.l. 7·5 mm.

Genus Heteropanope, *Stimpson*, 1859.

51. Heteropanope vauquelini (*Audouin et Savigny*, 1826). *See* Heller, **1861**, p. 344.

> *Pilumnus Vauquelini*, Heller, *loc. cit.*
> *Heteropanope Vauquelini*, Nobili, **1906**, p. 285.

Localities. Station I. B, 7 ♂ [258–264], 5 ♀ [265–269]; Station I. C, 4 ♂ [270–273]; 9 ♀ [274–282]; Station I. D, 1 ♂ [283], 10 ♀ [284–293]; Station I. E, 3 ♂ [294–296], 10 ♀ [297–306] ; Station I. H, 1 ♂ [307] ; no locality given, labelled "Sponge Inhabiters, 11 Jan., 1905," 2 ♂ [308, 309], 3 ♀ [310–312] ; no locality given, labelled "Trials I.," 1 ♂ [313], 3 ♀ [314–316].

Remarks. There are 59 specimens in all. C.l. ranges in ♀ from 2·75 to 7·25 mm. and in ♂ from 2·75 to 8·25 mm. None of the ♀ specimens are ovigerous, but all having C.l. 4 mm. or over, with the exception of two, have an adult appearance. The largest ♂ has C.l. 8·25 mm. and C.b. 11·5 mm., so that C.l. × C.b. = ·72.

Of 50 specimens 35 (12 ♂ and 23 ♀) have the right hand, and 15 (7 ♂ and 8 ♀) the left hand, the more massive. Heller also found that in his examples it was generally the right hand which was the larger.

The specimens agree very fairly with Heller's description (*loc. cit.*) and Savigny's figure (Savigny, **1826**, pl. 5. fig. 3). There is a good deal of variation in the distribution of hair on the carapace, a point noted also by

Nobili. The lower border of the orbit is granular or crenulated in all the specimens, which was the case in Nobili's examples.

The carapace of ♀ 284 is asymmetrical and abnormal in regard to its antero-lateral teeth ; on its left side the second tooth is reduced to a slender spine and on its right side only two teeth are present.

Genus TRAPEZIA, *Latreille*, 1825.

52. TRAPEZIA CYMODOCE (*Herbst*, 1801). *See* Alcock, **1898**, p. 219.

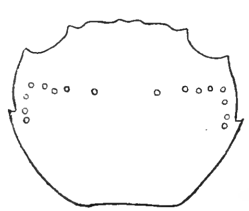
Trapezia cymodoce, Nobili, **1906**, p. 292.
Trapezia cymodoce, Laurie, **1906**, p. 410.
Grapsillus cymodoce, Rathbun, **1906**, p. 865, pl. 11. fig. 6.
Trapezia cymodoce, Rathbun, **1911**, p. 234.

Localities. Station I. D, 1 ♂ [317]; Station V. D, 1 ♀ juv. [318]; Station V. E, 1 ♂ [319], 2 ♀ [320–321] ; Station VII. B, 3 ♂ [432–434]; Station VII. D, 16 ♂ [322–335, 359, 360], 15 ♀ [336–349, 361] (9 ovig.); Station IX. A, 1 ♂ [362] ; no locality given, 3 ♂ [356–358], 9 ♀ [350–355, 363–365] (4 ovig.).

Remarks. In all 52 specimens, except only the large ♂ 360, the outer division of the frontal lobe of each side is seen to be crenulated when examined through a lens.

In most of the specimens a transverse line of rounded red spots is more or less evident on the carapace when carefully looked for. In no case is this

Fig. 2.



Trapezia cymodoce. Dorsal view to show position of line of spots.

line obvious to the naked eye at a casual glance, but on a more careful examination, especially with a hand-lens, it can be made out very completely in seventeen specimens (in ten of which, however, the colour appears to have faded, leaving the spots whitish), incompletely in seven, an inner pair of spots only in twelve, and not seen in sixteen. Of those specimens in which it is not seen twelve are quite small ; other small specimens, however, have it present. It appears as if the presence of the complete line is normal in the living condition and that the other less complete conditions represent stages in fading of spirit-specimens. Even in some of those described above as not showing it, traces were discovered on careful examination under a Zeiss

binocular dissecting microscope. The line under consideration commences on either side just inside the lateral epibranchial spine and runs forwards to curve inward halfway between this and the outer orbital tooth, then running inward and slightly backward to terminate in a spot somewhat larger than the others well to the side of the middle line. Thus the whole line is divided into right and left halves, which are symmetrical. The spots are closer together on the branchial portions of the line.

The growth-changes in this species are considerable, as the following table will illustrate:—

No. of specimen.	Sex.	C.l.	C.b.	C.b./C.l.	Antero-lateral borders of carapace.	Condition of lateral epibranchial tooth.	Condition of teeth on anterior border of merus of cheliped.	Condition of teeth on anterior border of carpus of cheliped.
		mm.	mm.					
362.	♂	2·8	..	..	Anteriorly divergent.	Spiniform.	Spiniform, procurved.	Spiniform.
363.	♀	3·5	..	..	"	"	"	Acute.
364.	♀ ovig.	6·0	..	..	Approx. parallel.	"	Acute, procurved.	"
365.	♀	7·75	..	..	Anteriorly convergent.	"	"	"
359.	♂	10·75	12·5	1·16	"	Blunt.	Squarish, procurved.	Blunt.
360.	♂	13·0	15·5	1·19	"	Notch.	Blunt, a little procuved.	Absent.
361.	♀ ovig.	13·0	17·0	1·31	"	Obscure notch.	"	"

During growth the main changes are (1) from spiniform armature to an armature which is more blunt and less conspicuous; (2) from anteriorly divergent to anteriorly convergent antero-lateral borders of the carapace.

The large difference in size between the two ovigerous females should be noted. The smaller specimen has reached the egg-beariag stage, while still showing the general characters appropriate to a comparatively early growth-stage.

The different ratio between carapace length and breadth in the large males and the large female will be noted, due to the greater relative width of carapace in the female.

Out of seventeen ♂ specimens with C.l. ranging from 6 to 15 mm., eleven have the left and six the right hand the more massive.

Var. *edentula*.—I suggested this name for a specimen from Ceylon (*loc. cit.*), in which the lateral epibranchial tooth was absent and the hand naked. The former character appears of doubtful value, in view of the considerable

changes during growth indicated by the above table ; but specimens 359–365 of the present collection have also a naked hand. (As the specimens happen to make a convenient series in regard to size I have used them for the table above).

52 *a*. TRAPEZIA CYMODOCE, var. MACULATA (*Macleay*, 1838). *See* Alcock, **1898**, p. 221.

Trapezia maculata, Alcock, *loc. cit.*
Trapezia maculata, Nobili, **1906**, p. 293.
Trapezia maculata, Laurie, **1906**, p. 410.
Trapezia maculata, Stimpson, **1907**, p. 73.
Grapsillus maculatus, Rathbun, **1906**, p. 865.
Trapezia cymodoce maculata, Rathbun, **1911**, p. 235.

Locality. Station VII. D, 1 ♂ [366], 1 ♀ ovig. [367].

Remarks. ♀ ovig. 367 has C.l. 14·5 mm., greatest C.b., a line joining points of union of antero-lateral and postero-lateral borders, 17·5 mm., Ch.l. 28 mm., merus l. measured from most proximal to most distal point of lower surface 9 mm. ; C.b. across region of outer orbital teeth 15 mm., so that the antero-lateral borders, which are a little convex, slope inwards anteriorly. The outer angle of the orbit is pointed. The inner angle of the lower margin of the orbit bears a sharp tooth. The boundary between the antero-lateral and postero-lateral borders of the carapace is marked by a blunt tubercle. The inner angle of the wrist bears a blunt pointed tubercle in place of a spine. There are 118 red spots visible in a dorsal view of the carapace, a few of them tending to run together in pairs on the lateral portions of the gastric regions.

Specimen ♂ 366 is small, C.l. 5 mm., C.b. measured by a line joining points of union of antero-lateral and postero-lateral borders 6 mm. ; a line uniting the outer orbital teeth 6·25 mm. It differs from the ♀ ovig. 367 in (*a*) the sharp spiniform character of the denticles marking the outer angle of the orbit, the inner angle of the lower margin of the orbit, the boundary between the antero-lateral and the postero-lateral borders of the carapace, the inner border of the arm and the inner border of the wrist ; (*b*) the almost straight character of the frontal border, the teeth being very little marked ; (*c*) the antero-lateral borders of the carapace slope a little outward anteriorly; (*d*) the number of red spots visible on the carapace in dorsal view is small, namely, twenty-eight.

The points mentioned above in regard to the small ♂ are probably marks of youth. The specimen bears a close resemblance to a ♀ of the same size and a rather larger ♂ (C.l. 7 mm.), both from Ceylon, which I have before me (Laurie, *loc. cit.*). The Ceylon ♂, however, is somewhat intermediate in the character of its front between the two present specimens and

has 48 red spots visible in a dorsal view of the carapace; the Ceylon ♀ has also 48 spots approximately, but it is difficult to count the number accurately, as they are in a very faded condition.

Genus Tetralia, *Dana,* 1851.

53. Tetralia glaberrima (*Herbst,* 1790). *See* Alcock, **1898**, p. 223.

Tetralia glaberrima, Nobili, **1906**, p. 294.
Tetralia glaberrima, Nobili, **1907**, p. 143.
Tetralia glaberrima, Stimpson, **1907**, p. 74.

Localities. Station III., 1 ♀ ovig. [368]; Station V. E, 1 ♀ ovig. [369]; Station VII. B, 1 ♀ ovig. [370]; Station VII. D, 2 ♂ probably adult [371–372], 3 ♀ ovig. [374–376].

Remarks. An ovigerous ♀ has C.l. 9 mm. and C.b. 10·5 mm.

In two of the females the left cheliped, and in the other six specimens the right cheliped, is the larger.

Family GONEPLACIDÆ.

Genus Libystes, *A. Milne-Edwards.,* 1867.

54. Libystes nitidus, *A. M.-Edw.,* 1867. *See* A. M.-Edw. **1868**, p. 83, pl. 20. figs. 5–7.

Lybystes nitidus, Nobili, **1906**, p. 297.

Localities. Station VI. 1 ♂ [377]; Station VIII. A, 1 ♂ [378], 3 ♀ [379–381].

Remarks.

	♀ 379.	♀ 380.	♀ 381.	♂ 378.	♂ 377.
C.l.	5·75	7·25	7·75	4·0	7·75 mm.
C.b.	8·5	11·25	12·0	6·0	13·0 mm.
C.b.÷C.l.	1·48	1·55	1·55	1·50	1·68
Lower bord. propus right cheliped	7·25	9·75	10·25	5·0	12·0 mm.
Height propus right cheliped	2·5	4·0	3·5	1·75	3·75 mm.
Lower bord. propus left cheliped	7·0	9·0	9·5	5·0	12·0 mm.
Height propus left cheliped	2·0	2·5	2·5	1·25	3·75 mm.

All the specimens have a uniformly fine granulation on the antero-lateral margin of the carapace; there are no denticles on this margin such as Nobili describes for his small ♀ (C.l. 7·5 mm.) from Djibouti, and looked upon by him as a condition of youth.

In the larger ♂ specimen the hands are similar. In the smaller ♂ and in the ♀ specimens there is a good deal of difference between the hands, the right being in each case much more massive than the left, though not much longer. In specimens 380 and 381 the fixed finger of the less massive left hand bears on its distal half 3 spiniform teeth, of which the middle one is the largest, in the small ♀ 379 the proximal of the three teeth is absent. In

the small ♀ 379 the larger right hand makes an approach to Milne-Edwards's fig. 7, the lower border being slightly concave near the base of the fingers and the fingers not markedly hooked at tips; in the more slender left hand of the same specimen the ends of the fingers are strongly curved towards each other, which condition occurs also in both hands of all the other examples.

It will be noted, as pointed out above, that though in the smaller ♂ one hand is more massive than the other, yet in the larger ♂ the two hands are equally massive.

Genus Litocheira, *Kinahan*, 1856.

Original orthography *Litocheira*, not *Litochira*; see Kinahan, **1856**, p. 116.

55. Litocheira integra (*Miers*, 1884). (Plate **45**. fig. 2.) *See* Alcock, **1900**, p. 314.

Litochira integra, Alcock, *loc. cit.*
Carcinoplax integra, Miers, **1884**, p. 543.

Localities. Station V. A, 1 ♂ [382], 1 ♀ ovig. [383]; Station V. B, 1 ♂ [384], 2 ♀ [385, 386].

Remarks. The specimens agree with Alcock's description of the genus and species. Miers's figure (**1884**, pl. 48. fig. C) would have given a good idea of the present examples if the fringing setæ, even of the front, had been made longer. Many of the very long fine setæ which fringe the front, the antero-lateral borders, the chelipeds, and the walking-legs are in the present specimens more than one-half as long as the carapace, and give a very beautiful appearance to the creatures.

I give an anterior view of the front with the setæ removed, which is "turned down and distinctly arched"—a character of the genus *Litocheira*, to which Alcock calls attention.

Miers gives dimensions of his ♀ specimen as C.l. 4 mm. and C.b. 5 mm., but this may be a slip, as his figure, drawn to scale, gives ratio as 4 to 6. De Man (**1888**, p. 93) cites a ♂ as having C.l. 7·75 and C.b. 10·25 mm. Alcock gives a ♀ as 6 × 9. The measurements in the present specimens are as follows:—

	♀ 385.	♀ ov. 386.	♀ ov. 383.	♂ 382.	♂ 384.
C.l.	2·5	4·0	4·2	2·75	3·75 mm.
C.b.	3·5	5·75	6·1	4·0	5·25 mm.
C.l.÷C.b.	·71	·70	·69	·69	·71

In the ovigerous female 383 the breadth of the frontal margin is 2 mm., and a line uniting the external angles of the orbits measures 4·25 mm.

Both genus and species are new to the Red Sea.

Family PINNOTHERIDÆ.

Genus Ostracotheres, *H. Milne-Edwards*, 1853.

Original orthography *Ostracotheres*, not *Ostracoteres*; see H. Milne-Edwards, **1853**, p. 219.

56. Ostracotheres cynthiæ, *Nobili*, 1905. (Pl. **45**. figs. 3–3 *b*.) *See* Nobili, **1906**, p. 301.

Ostracoteres cynthiæ, Nobili, *loc. cit.*

Locality. No locality given, 1 ♂ [390].

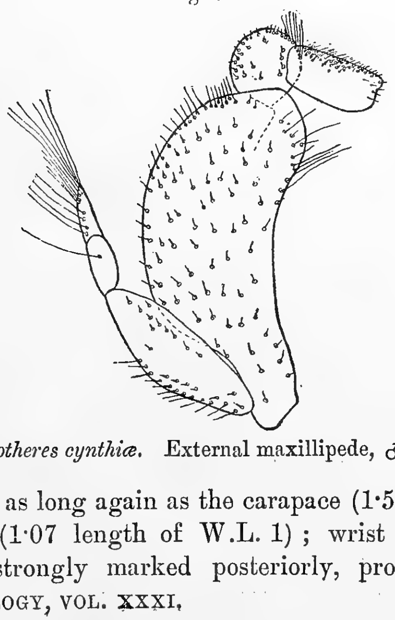
Remarks. After characterising the species from a ♀ example by pointing out that, among other things, its carapace is quadrangular rather than globular and that the dactylus of the last walking-leg is long, flattened, hairy, and has a sinuous margin, Nobili adds that in the ♂ the carapace is more rounded and the dactylus of the last walking-leg differs little from those of the others.

In the present specimen the carapace is almost, though not altogether, circular, with the posterior border convex. It is seen under a lens to be faintly pitted and to bear a few scattered very short inconspicuous setæ.

The deflexed anterior obtusely pointed tip of the front is only seen in an anterior view of the animal.

The distal end of the propodite of the third maxillipede differs from Nobili's description and figure, for, instead of being obliquely truncated, it is the same width distally as elsewhere and its distal margin is concave. The form of this appendage is important in species of *Ostracotheres*.

Fig. 3.



Ostracotheres cynthiæ. External maxillipede, ♂ 390.

Cheliped stout, half as long again as the carapace (1·58 C.l.), a little longer than walking-leg 1 (1·07 length of W.L. 1); wrist swollen; hand with lower outer border strongly marked posteriorly, producing a triangular

appearance; the tip of the fixed finger is pointed and curved and lies against the outer side of the more strongly curved tip of the dactylus; dactylus about three-quarters as long again as the upper border of the propus (1·71 upper border propus), its tip very strongly curved—at the base of its apposed border is a large triangular tooth and a smaller one on the distal half of the same border corresponding to a similarly placed one on the fixed finger; the fingers meet only at their tips, which cross as above indicated, the considerable gape being occupied by fine downy hairs. The whole cheliped, more particularly the inner surface of the hand, is covered with fine down.

The first three walking-legs are of equal length and each is a little shorter than the cheliped and 1·48 C.l.; W.L. 4 is shorter (1·3 C.l.). The dactyli of W.L. 1, 2, and 3 are equal in length (0·23 C.l.), that of W.L. 4 is longer (0·28 C.l.), but of very similar form.

Some measurements of the specimen are as follows:—C.l. 6 mm.; C.b. 6 mm.; Ch.l. 9·5 mm.; lower bord. propus Ch. 1·75 mm.; F.l. 3·1 mm.; W.L. 1, 2, and 3 are each 8·9 mm.; W.L. 4 is 7·8 mm.; dactylus l. of W.L. 4 is 1·7 mm.

It will be noted that in Nobili's key of *Ostracotheres* the place of *O. cynthiæ* is determined by characters of the ♀; the key is of doubtful value in identifying a ♂ example.

Nobili does not figure the species, save for a text-figure of part of the third maxillipede (sex not stated).

As Nobili's reference to the ♂ is not very precise, and his description and figure of the propodite of the external maxillipede do not agree with mine, it is just possible that the present specimen represents a new species; should this be so, the almost circular carapace and the form of the propodite of the external maxillipede are characters to be noted more especially.

Genus PINNOTHERES, *Bosc*, 1802.

Original orthography *Pinnotheres*, not *Pinnoteres*.

57. PINNOTHERES PILUMNOIDES, *Nobili*, 1905. *See* Nobili, **1906**, p. 307, fig. 12.

Pinnoteres pilumnoides, Nobili, *loc. cit.*

Localities. No locality given, labelled "Trials I., mostly from sponge," 1 ♀ adult non-ovig. [387]; no locality given, labelled "From *Holothuria gallensis*," 2 ♀ ovig. [388, 389].

Remarks.

	♀ 387.	♀ ov. 388.	♀ ov. 389.
Cl.	10·0	10·0	12·25 mm.
C.b.	11·0	11·5	14·25 mm.
Post. bord. C.	4·0	5·0	6·0 mm.
C.l.÷C.b.	·91	·87	·86
Post. bord. C.÷C.b.	·36	·43	·42

It is difficult to give accurate measurements, owing to the slight degree of calcification of the carapace. Those of specimen 387 are the most reliable.

Specimen 389 carries 714 eggs, each having a diameter of about 0·75 mm.

Family OCYPODIDÆ.

Genus Ocypode, *Fabricius*, 1798.

Original orthography *Ocypode*, not *Ocypoda*; see Miers, **1882**, p. 376.

58. Ocypode ægyptiaca, *Gerstäcker*, 1856. *See* Miers, **1882**, p. 381, pl. 17. fig. 3.

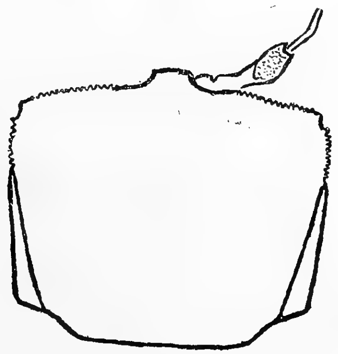
Ocypoda ægyptiaca, Miers, *loc. cit.*
Ocypoda ægyptiaca, Nobili, **1906**, p. 310.
Ocypoda ægyptiaca, Nobili, **1907**, p. 152.

Locality. Station IX. B, 1 ♂, probably adult [391].

Remarks. C.l. 36 mm. The stridulating organ is composed of 80 ridges in this example.

The outer orbital angles undergo considerable growth-change in this species (see Nobili, **1906**, *loc. cit.*). The text-figure shows their condition in the present specimen, and also an eye-stalk with its characteristically curved terminal style.

Fig. 4.



Ocypode ægyptiaca. ♂, C. 136. mm.

Genus Dotilla, *Stimpson*, 1859.

59. Dotilla sulcata (*Forskål*, 1775). *See* Alcock, **1900**, p. 365.

Dotilla affinis, Alcock, *loc. cit.*; and **1902**, pl. 63. fig. 1.
Dotilla sulcata, Nobili, **1906**, p. 315.

Locality. Station I. B, 9 ♂ [392–400], 4 ♀ [401–404].

Remarks. The present specimens enable me to add further evidence in favour of Nobili's suggestion (Nobili, *loc. cit.*) that *Dotilla affinis*, formed in

1900 by Alcock for four specimens from Aden and the Baluchistan coast, is a synonym of this species.

The characters by which Alcock separates his species from *D. sulcata* are: (1) the absence of the spine from the under surface of the arm; (2) the presence of a tympanum on the dorsal surface of the merus of the last pair of walking-legs, and (3) the fact that the fingers are *shorter* than the palm. The condition of each of these characters in my specimens is shown in the following table:—

No. of specimen.	Sex.	C.l.	H.l. (upper bord.).	F.l.	H.l./F.l.	Meral spine.	Tympanum.
		mm.	mm.	mm.			
401.	♀	5·6	1·5	3·0	2·00	Absent.	[Leg lost.]
402.	♀	5·9	1·5	3·0	2·00	Absent.	Present.
403.	♀	6·0	1·5	3·0	2·00	Absent.	Present.
404.	♀	6·5	1·6	3·5	2·19	Absent.	[Leg lost.]
					Average in 4 ♀s = 2·05.	Absent in all.	Present in both.
392.	♂	5·0	2·0	3·0	1·50	Absent.	Present.
393.	♂	5·9	1·9	3·4	1·79	Absent.	Absent.
394.	♂	6·0	2·1	3·2	1·52	Absent.	Absent Rt. [Left lost.]
395.	♂	6·0	2·0	3·5	1·75	Absent.	Trace.
396.	♂	6·0	2·0	3·2	1·60	Absent.	Present.
397.	♂	6·0	2·5	3·7	1·48	Absent.	Present.
398.	♂	6·5	2·5	3·8	1·52	Absent.	Present.
399.	♂	7·0	2·8	3·9	1·39	Trace.	Present.
400.	♂	7·5	3·0	4·2	1·40	Present.	Present.
					Average in 9 ♂s = 1·55.	Absent 7. Trace 1. Present 1.	Present 6. Trace 1. Absent 2.

It will be noted from the above table that the most usual condition is for the spine to be absent and the tympanum present, this occurring in six instances (seven if 395 be included); but in one specimen (two if 399 be included) both spine and tympanum are present, and in two specimens both are absent. This agrees with Nobili's results.

The remaining point of difference, namely, the relative size of hand and

fingers, appears from the measurements given above to be clearly a sex-difference.

Summarising available data in regard to all these characters one finds :—

	Meral spine.	Tympanum.	Ratio of H.l. to F.l.
D. sulcata (Forskål)	Present.	Absent.	Fingers longer than hand.
D. affinis, Alcock, 1900, 4 specimens, sex not stated.	Absent.	Present.	Fingers shorter than hand.
Nobili's *D. sulcata*, 24 ♂s and 2 ♀s.	Absent in 17. Present in 3.	Present in 14. Absent in 6.	Fingers longer than hand in 24. Fingers and palm subequal in 2.
Present specimens	Absent in 11. Trace in 1. Present in 1.	Present in 8. Trace in 1. Absent in 2.	H.l. (upper bord.)÷F.l. gives for 4 ♀s an average of 2·05 and range of variation from 2 to 2·2 mm.; for 9 ♂s an average of 1·55 and range of variation from 1·4 to 1·8 mm.

Alcock does not state the sex of his four specimens; I suggest that they were females. Nobili, though giving the sex of his, does not relate it to finger length, probably the two in which the fingers and hand were subequal were the two females of his collection.

N.B.—I have taken finger length as being the length of the dactylus; hand length might be measured in various ways, I have measured the well-defined upper border, the authors quoted above evidently estimated the less easily measurable "greatest length."

Genus Paraclistostoma, *de Man*, 1895.

60. Paraclistostoma leachii (*Audouin et Savigny*, 1826). *See* Audouin, **1826**, p. 81 ; Savigny, **1826**, pl. 2. fig. 1.

> *Macrophthalmus Leachii*, Audouin, *loc. cit.*; Savigny, *loc. cit.*
> *Paraclistostoma Leachii*, Nobili, **1906**, p. 316.

Localities. Station I. A, 1 ♂ probably adult [405], 2 ♀ ovig. [406, 407] ; Station I. E, 2 ♂ probably adult [408, 409], 1 ♀ ovig. [410].

Remarks. C.l. ♀ ovig. 8 mm.

In each ♀ the anterior surface of the propodite of W.L. 3 is hairless, whereas in each ♂ it is densely clothed with hair ; this confirms Nobili's suggestion that such a hairy patch is a sex-distinction and not, as regarded by Paulson, a varietal one.

The demarcation of the regions of the carapace varies somewhat in distinctness ; the slight difference in Savigny's excellent figures between ♂ and ♀ carapace markings is evidently not a sex-distinction, as in both males in the present collection the transverse line across the branchial region is faintly indicated.

Genus MACROPHTHALMUS, *Latreille*, 1829.

61. MACROPHTHALMUS VERREAUXI, *H. Milne-Edwards*, 1848. *See* Alcock, **1900**, p. 377.

> *Macrophthalmus Verreauxi,* Alcock, *loc. cit.*
> *Macrophthalmus Verreauxi,* Nobili, **1906**, p. 317.

Locality. Station VIII. C, 1 ♀ ovig. [411].

Remarks. C.l. 6 mm., C.b. 9·5 mm., frontal b. between eye-stalks 2 mm., eye-stalk l. including eye 7·75 mm.

62. MACROPHTHALMUS GRAEFFEI, *A. Milne-Edwards*, 1873. *See* A. Milne-Edwards, **1873** (**2**), p. 81, pl. 13. fig. 5.

Locality. Station VIII. A, 1 ♂ [412], 5 ♀ [413–417].

Remarks.

	♀ juv. 413.	♀ ov. 414.	♀ 415.	♀ ov. 416.	♀ 417.	♂ 412.
C.l.	7·25	12·0	12·0	12·75	12·75	11·0 mm.
C.b. across and including outer orbital angles	12·0	21·5	22·0	22·75	23·75	20·25 mm.
Frontal b. between eye-stalks......	1·5	2·0	2·1	2·25	2·25	2·0 mm.
Ch.l.	..	18·0	18·5	19·5	19·5	23·0 mm.
C.b.÷C.l.	1·65	1·79	1·83	1·78	1·86	1·84
Frontal b.÷C.b. ..	·12	·09	·10	·10	·09	·10

The only example hitherto recorded is A. Milne-Edwards's type-specimen from Upolu, one of the Samoan Islands. With his description and figures the present specimens agree except in (*a*) the proportion of length to breadth of the carapace, the measurements in Milne-Edwards's type-specimen, probably a young ♀, being C.l. 7 mm. and C.b. 14 mm.; (*b*) the granulation of the branchial regions, which is probably more distinct in my specimens; (*c*) the shape of the abdomen, which in my ♂ differs from Milne-Edwards's figure; as, however, the latter represents very well the abdomen of my young ♀ of C.l. 7·25 mm., it appears that Milne-Edwards's figure is wrongly labelled in regard to sex, and that no real difference is involved under this head.

In addition to the points given in Milne-Edwards's description, my specimens have (*a*) some hair distributed in various places, and (*b*) some granulation on the walking-legs. In detail, hair occurs (i.) on lateral borders of the carapace; (ii.) on upper border of the merus of 1st, 2nd, and 3rd pairs of walking-legs; (iii.) on both borders of the 4th pair of walking-legs, except that it is almost absent from the lower border of the carpus and distal half of the lower border of the merus; on this 4th pair, moreover, the hair is more strongly developed than on the meri of the first three pairs; (iv.) in all the females on the upper border of the cheliped and flanking the

margins of the apposed borders of the fingers. The granulation occurs on both borders of the meri, the upper borders of the carpi, and both borders of the propi of the walking-legs, also traces on outer surface of the 3rd and 4th pairs more particularly; the granulation of the lower borders of the meri of the 2nd and 3rd pairs of walking-legs is visible to the naked eye.

Perhaps an important point about *M. graeffei* (my specimens included) is that the eye-stalk extends just beyond the tip of the outer orbital tooth (for a distance approximately equal to the length of the tooth) ending in a blunt point or tubercle drawn out distal to the pigmented region. The spiniform outer orbital tooth reaches to about the middle of the pigmented region.

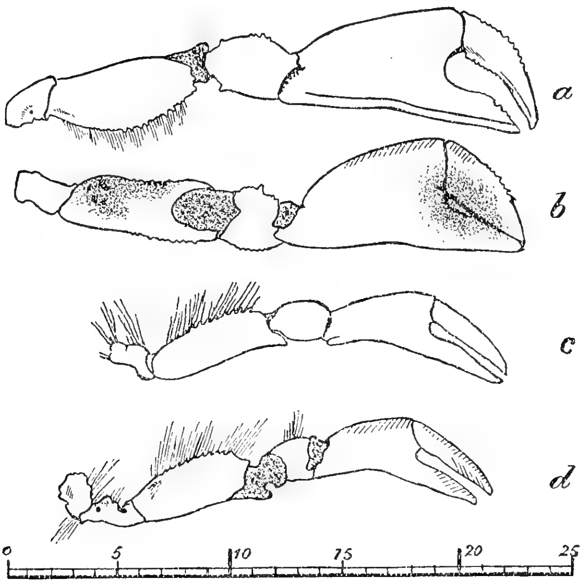
Macrophthalmus graeffei is evidently closely related to *M. convexus*, Stimpson, 1858 (Stimpson, **1907**, p. 97, pl. 13. fig. 2 *a–b*), and *M. inermis*, A. Milne-Edwards, 1867 (A. Milne-Edwards, **1873** (**1**), p. 277, pl. 12. figs. 5, 5 *a*), but differs from both in (*a*) the relative length of the eye-stalks, which in both the latter do not extend beyond the orbit and so fall short of the tip of the outer orbital tooth; (*b*) the more spiniform and more transversely disposed character of the antero-lateral teeth of the carapace; this is particularly seen in the 1st, *i. e.* the outer orbital angle, since this is the largest, but is also well seen in the second one; (*c*) the merus of each of the first three pairs of walking-legs bears a subterminal tooth; in *M. convexus* the merus of the 4th pair also has such a tooth, though, in five specimens from the Andaman Islands described by Alcock, it was absent not only from the fourth pair, but also from the first pair; in *M. inermis* none of the meri of walking-legs bear such a tooth.

M. graeffei agrees with *M. inermis* and differs from *M. convexus* in the degree of pilosity of the inner surface of the chelæ. In all three the inner surface of the fingers is pilose, but while the inner surface of the hand is pilose also in *M. convexus* the pilosity is confined in *M. inermis* and in *M. graeffei* to the distal margin bordering the fingers (see Milne-Edwards's figure of both, *loc. cit.*). I give outlines from photographs of chelipeds of ♂ and ♀ specimens of *M. graeffei*.

Alcock's treatment of *M. inermis* as a synonym of *M. convexus* appears to me to be open to question. The two species agree in the length of the eye-stalks as well as in many other ways, but Milne-Edwards's text and figure both describe *M. inermis* as having only two antero-lateral teeth on the carapace; the difference in subterminal meral spines of walking-legs and in pilosity of the inner surface of the hand have been noted above, and a comparison of the figures of Milne-Edwards and Stimpson suggests various points of difference in carapace form.

I find also that Rathbun (**1906**, p. 834), in recording *M. inermis* from the Hawaiian Islands, states very definitely her view that it is quite another species from *M. convexus*.

Fig. 5.



Macrophthalmus graeffei.

a. Right cheliped, ♂ 412: outer surface, setæ removed from gape of fingers.
b. Left cheliped, ♂ 412: inner surface.
c. Right cheliped, ♀ ov. 414: outer surface.
d. Left cheliped, ♀ ov. 414: inner surface.

(Each division of the enlarged scale represents 1 mm.)

63. Macrophthalmus depressus, *Rüppell*, 1830. *See* Alcock, **1900**, p. 380.

Macrophthalmus depressus, Nobili, **1906**, p. 318.
Macrophthalmus depressus, Nobili, **1907**, p. 155.

Locality. Station I. B, 1 ♂ [418], 1 ♀ [419].

Remarks. The female is non-ovigerous, but probably adult, C.l. 10 mm.; the male also is probably adult, C.l. 11 mm.

Family GRAPSIDÆ.

Genus Metopograpsus, *H. Milne-Edwards*, 1853.

64. Metopograpsus messor (*Forskål*, 1775). *See* Alcock, **1900**, p. 397.

Metopograpsus messor, Nobili, **1906**, p. 320.
Metopograpsus thukuhar, Stimpson *, **1907**, p. 114, and synonymy.
Metopograpsus messor, var. *frontalis*, Miers, **1880**, p. 311.

* Stimpson includes a reference to "*Metopograpsus thukuhar* Milne Edwards, Mélanges Carcinologiques, p. 131." I do not know the latter publication under the title given, but internal evidence shows that the reference is equivalent to H. Milne-Edwards, **1853**, p. 165.

Localities. Station I. A, 1 ♂ [420], 2 ♀ [421, 422]; Station I. B, 1 ♂ [423], 3 ♀ [424–426]; Station I. E, 3 ♂ [427–429], 1 ♀ [430].

Remarks. Miers observed "some variation in the width of the front in this species," and one of the characters of his var. *frontalis* is its wide front, this being "almost three and a half times the length of the upper orbital margin." I give, therefore, the following measurements and ratios:—

	424♀.	425♀.	426♀.	421♀.	430♀.	422♀.	427♂.	423♂.	428♂.	429♂.	420♂.
C.l.	11·75	16·75	17·0	18·5	20·25	21·0	10·0	16·5	21·0	23·0	27·0 mm.
C.b.	16·0	22·0	23·0	24·5	26·25	28·0	14·0	21·25	26·75	29·25	35·0 mm.
Frontal b..................	10·0	14·25	15·0	16·0	17·0	17·5	8·8	13·5	17·5	19·25	22·0 mm.
Major diameter orbit ...	3·5	4·5	4·5	4·75	5·25	5·5	3·0	4·5	5·75	5·5	6·5 mm.
Diam. orb. ÷ frontal b. ..	·35	·31	·30	·30	·31	·31	·34	·33	·33	·28	·30

It will be noted that the ratio greatest diameter of orbit ÷ frontal breadth is less in the larger forms. In specimen 429 the ratio is as in var. *frontalis*, but the margin of the front has the characteristically sinuous form and not the straight character of var. *frontalis*.

Family PALICIDÆ.

Genus Palicus, *Philippi*, 1838.

65. Palicus whitei (*Miers*, 1884). *See* Alcock, **1900**, p. 453.

Palicus Whitei, Alcock, *loc. cit.*
Palicus whitei, Rathbun, **1911**, p. 240.

Locality. Station II., 1 ♀ ovig. [431].

Remarks. C.l. 14 mm. Although this species is easily separated from the allied *jukesii* of White by the character of the walking-legs and by other characters also, it should not be overlooked that there is indeed a crest or carina on the upper border of the carpopodites and propodites of the first three pairs of walking-legs, though, of course, of very slight dimensions as compared with that in *P. jukesii*; Alcock appears rather to overlook this point.

Miers's figure (Miers, **1884**, pl. 49. fig. C) gives an excellent idea of the present specimen.

A good account and drawings of *P. whitei* are given by Calman (Calman, **1900**, p. 31, pl. 2. figs. 14–19).

EXPLANATION OF THE PLATES.

PLATE 42.

Fig. 1. *Chlorodopsis arabica*, n. sp. ♂ specimen (♂ 204). × 5. Text, p. 450.
1 *a*. Do. do. Ventral view of anterior region of same specimen. × 5.
1 *b*. Do. do. Abdomen of same specimen. × 6.

PLATE 43.

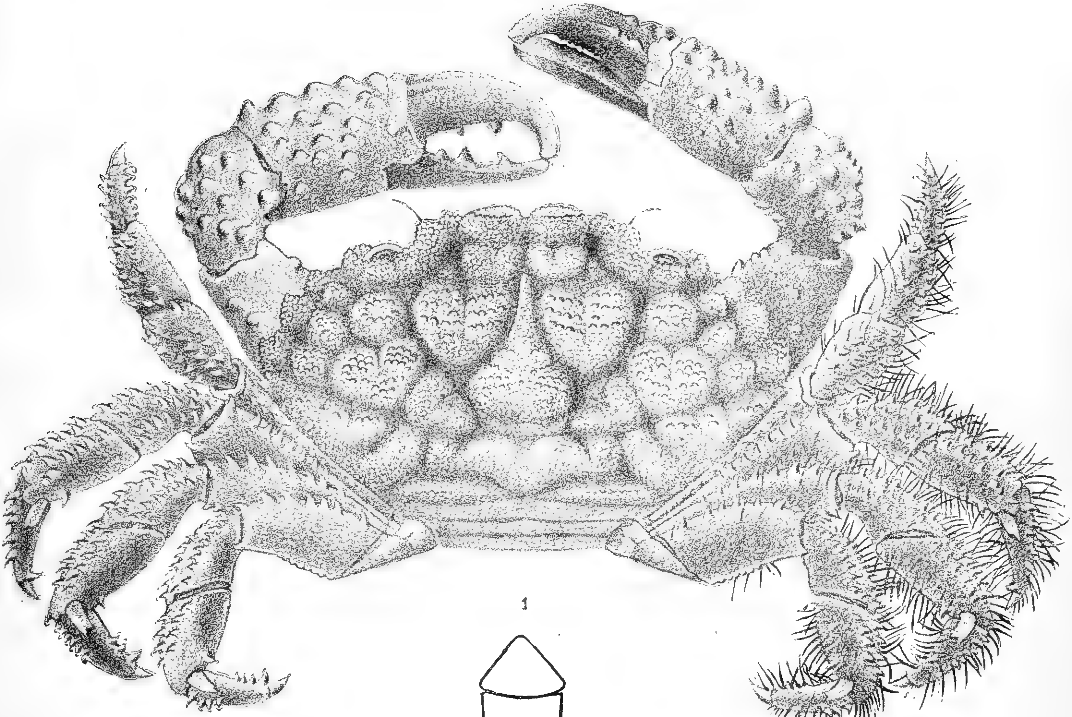
Fig. 1. *Xantho hydrophilus* (Herbst, 1790). Walking-leg, enlarged. Text, p. 444.
2. *Chlorodopsis arabica*, n. sp. First pair of abdominal appendages of ♂ specimen (♂ 204). × $6\frac{1}{4}$. Text, p. 450.
3 *a*. *Chlorodopsis spinipes* (Heller, 1861). Left chela ♂ (♂ 222, C.l. 5·25 mm.), outer surface. × $6\frac{1}{2}$ (actual length lower border 5·5 mm.). Text, p. 455.
3 *b*. Do. do. Right chela of same specimen, outer surface. × $6\frac{1}{2}$ (actual length lower border 5·75 mm.).
3 *c*. Do do. Left chela ♀ (♀ ovig. 218, C.l. 5 mm.), outer surface. × $6\frac{1}{2}$ (actual length lower border 5 mm.).
3 *d*. *Chlorodopsis spinipes* (Heller, 1861). Right chela of same specimen, outer surface. × $6\frac{1}{2}$ (actual length lower border 5·5 mm.).
4 *a*. *Chlorodopsis arabica*, n. sp. Left chela ♂ (♂ 203, C.l. 8·5 mm.), outer surface. × $6\frac{1}{2}$ (actual length lower border 9·5 mm.). Text, p. 450.
4 *b*. Do. do. Right chela of same specimen, outer surface. × $6\frac{1}{2}$ (actual length lower border 9 mm.).
4 *c*. Do. do. Left chela of ♀ specimen (♀ 211, C.l. 7·5 mm.), outer surface. × 7 (actual length lower border 6·5 mm.).
4 *d*. Do. do. Right chela of same specimen, outer surface. × 7 (actual length lower border 6·5 mm.).

PLATE 44

Fig. 1. *Lupa alcocki* (Nob., 1905). ♂. × $3\frac{1}{3}$. Text, p. 438.
1 *a*. Do. do. Ventral view of anterior region of same specimen. × 10.
1 *b*. Do. do. Anterior view of antero-ventral region of same specimen. × 10.
1 *c*. Do. do. Abdomen of same specimen. × 4.
2. *Herbstia corniculata*, Klunz., 1906. Left hand ♂. × 10. Text, p. 431.
3. *Cyphocarcinus minutus*, A. M.-Edw., 1868. ♀ 42, side view. × $11\frac{1}{2}$. Text, p. 433.

PLATE 45.

Fig. 1. *Caphyra monticellii*, Nob., 1901. Specimen 48. × 5. Text, p. 437.
1 *a*. Do. do. Ventral view of anterior region of same specimen. × 11.
2. *Lithocheira integra* (Miers, 1884). Ovig. ♀ 383 showing sharply turned down front etc. × 12. Text, p. 464.
3. *Ostracotheres cynthiæ*, Nob., 1905. ♂ 390. × $5\frac{1}{2}$. Text, p. 465.
3 *a*. Do. do. Ventral view of anterior region of same specimen. × 8.
3 *b*. Do. do. Abdomen of same specimen. × $5\frac{1}{2}$.
4. *Ophthalmias curvirostris* (A. M.-Edw., 1865). External maxillipedes (♀ ovig. 41, C.l. excluding rostral horns 23 mm.). × $5\frac{1}{4}$. Text, p. 431.
5. *Ophthalmias cervicornis* (Herbst, 1803). External maxillipedes (♀ orig. from Cheval Paar, Gulf of Manaar, C.l. excluding rostral horns 39 mm.). × $3\frac{3}{4}$. Text, p. 432.



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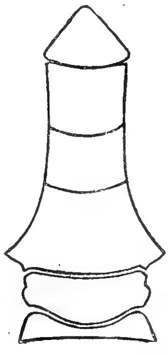

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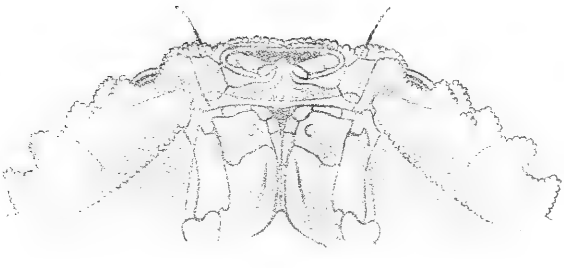

1a

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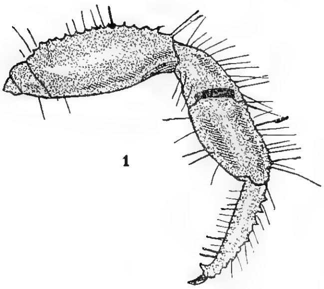
SUDAN BRACHYURA.



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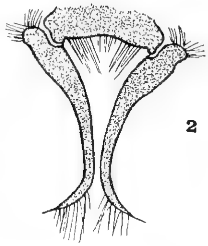

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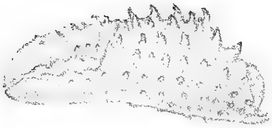

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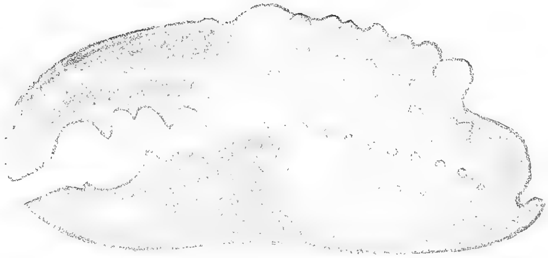
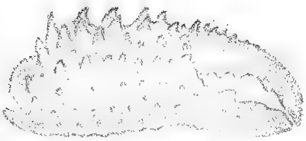
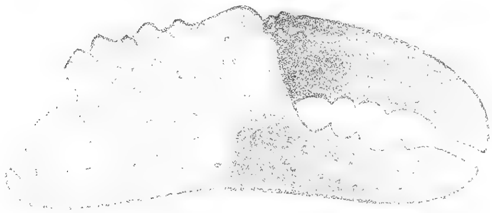


4a



3b



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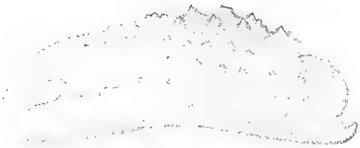
3c



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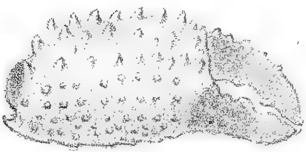
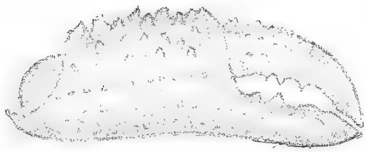


3d



4d

SUDAN BRACHYURA.

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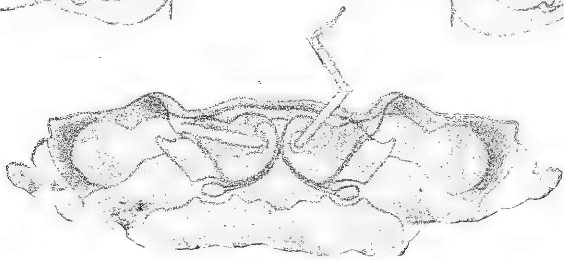
1a



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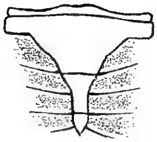

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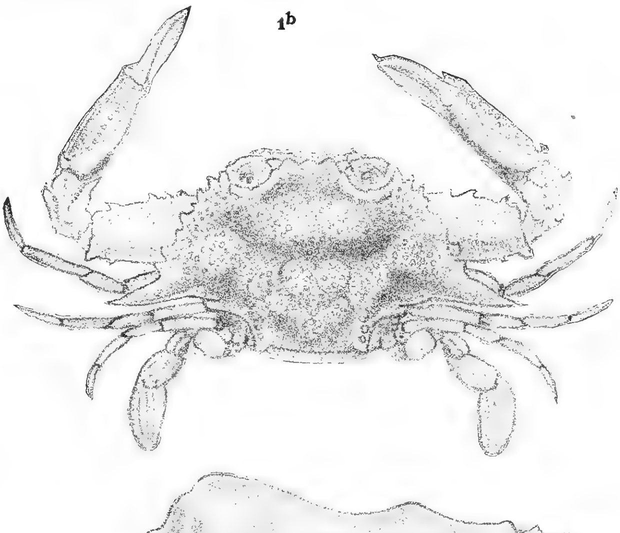

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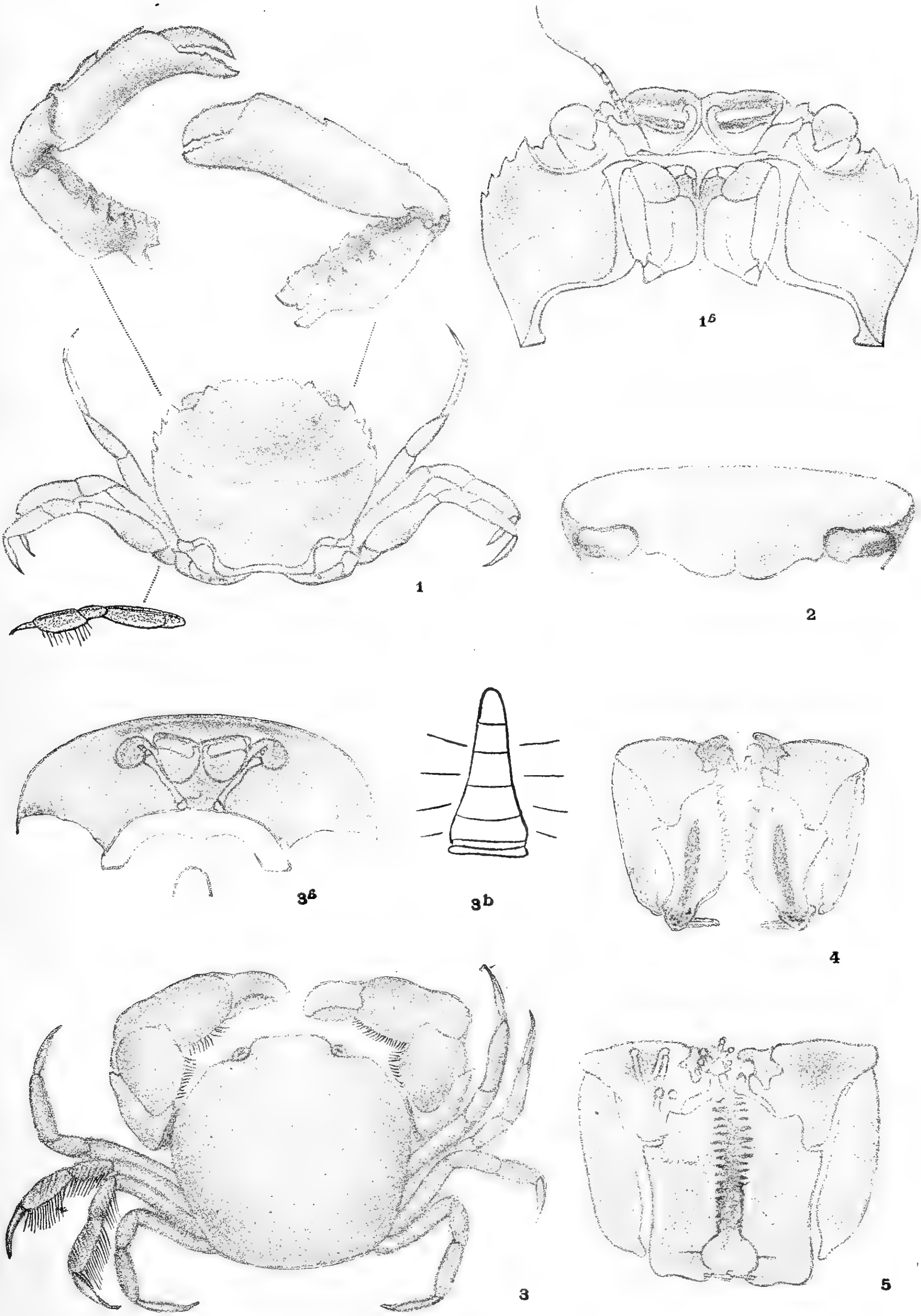

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Vol. **31**. Nos. 203–209.

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THE JOURNAL

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Reports on the Marine Biology of the Sudanese Red Sea, from Collections made by Cyril Crossland, M.A., D.Sc., F.L.S.—XXII. The Fishes.

By Ruth C. Bamber, M.Sc. (Liverpool). (Communicated by Prof. W. A. Herdman, F.R.S., F.L.S.)

[Plate 46.]

[Read 4th February, 1915.]

The fishes collected by Dr. Crossland from the western coast of the Red Sea, particularly from the vicinities of Suakim and Suez, comprise 238 specimens belonging to 91 species, two of which are new to science. One of these is the type of a new family of Eels. Most of the species are typical Red Sea forms, but several have not been recorded previously from that region.

The collection was sent by Dr. Crossland to the Zoology Department of the University of Liverpool, and was entrusted to me by Professor Herdman for investigation.

The greater part of the work was done in the Zoological Laboratory at Liverpool; but a few specimens that presented special difficulty were taken to the British Museum (Natural History), where Mr. Tate Regan gave me every facility for making use of the collection under his charge, and supervised my work.

When the locality is not stated, it may be taken to be the western shores of the Red Sea between Suez and Suakim.

Most of the fishes of this collection are in the Zoological Museum of the University of Liverpool; but a few, including the types of the two new species, are in the Natural History Museum (South Kensington).

CARCHARIIDÆ.

1. Carcharias bleekeri, *Duméril.*

TORPEDINIIDÆ.

2. Torpedo panthera, *Rüpp.*

3. Torpedo sinus-persici, *Duméril.*

RHINOBATIDÆ.

4. Rhinobatus granulatus, *Cuv.*

TRYGONIDÆ.

5. Trygon uarnak (*Forsk.*).

6. Trygon sephen (*Forsk.*).

MYLIOBATIDÆ.

7. Aëtobatis narinari (*Euphr.*).

CLUPEIDÆ.

8. Clupea moluccensis (*Bleek.*).

9. Engraulis boelama (*Forsk.*).

PLOTOSIDÆ.

10. Plotosus anguillaris (*Bloch*).

MURÆNIDÆ.

11. Gymnothorax hepatica (*Rüpp.*).

NEENCHELIDÆ, fam. nov.

Dorsal and anal fins continuous with the reduced caudal; pectorals present. Body naked; vent remote from head. Mouth with lateral cleft extending a short distance behind eye; maxillary articulated with ethmoid at a considerable distance behind end of snout, which is not much produced; teeth subconical, pointed, uniserial, well developed in jaws and on vomer. Nostrils lateral. Gill-openings separated. Pharyngeal openings of branchial clefts restricted. Pharyngeals oblong or ovate, covered with small teeth. Frontals ankylosed to form a single bone. Suspensorium vertical. Palato-pterygoid an elongated lamina. Caudal vertebræ without lateral transverse processes.

This family seems to be closely allied to the Murænesocidæ as defined by Regan ("Classification of Order Apodes," Ann. Mag. Nat. Hist. (8) vol. x. 1912), but differs in the small pharyngeal openings of the branchial clefts. The latter character suggests affinity with the Murænidæ, which differ notably in the structure of the pharyngeals, the paired frontals, and the vestigial palato-pterygoids. The lateral line also differs from that of the Murænidæ, consisting of long exposed tubules as in the Congridæ and Murænesocidæ.

Neenchelys, gen. nov.

Form elongate, subcylindrical. Snout subconical. Nostrils lateral; posterior a long narrow slit in front of eye; anterior tubular. Gill-openings small, widely separated. Teeth few, spaced, slender, and acute. Dorsal fin beginning a short distance behind the gill-opening; origin of anal just behind the vent; pectorals small.

12. Neenchelys microtretus, n. sp. (Plate **46**. fig. 3.)

Tail $1\frac{2}{5}$ as long as rest of fish. Depth of body nearly $\frac{1}{3}$ length of head (to gill-opening), which is nearly $\frac{1}{9}$ length of fish. Cleft of mouth extends behind eye for a distance equal to diameter of eye, which is small, about $\frac{1}{3}$ length of snout. Vertical fins low; origin of dorsal as far from gill-opening as latter is from angle of mouth. Pectorals narrow, few-rayed, shorter than snout. Coloration uniform (in spirit).

A single specimen, 185 mm. in total length, from Suez.

ECHELIDÆ.

13. Muræenichthys schultzii, *Bleek.*

POECILIIDÆ.

14. Cyprinodon dispar (*Rüpp.*).

BELONIDÆ.

15. Belone schismatorhynchus, *Bleek.*

HEMIRAMPHIDÆ.

16. Hemiramphus dussumierii, *Cuv. & Val.*

FISTULARIIDÆ.

17. Fistularia serrata, *Cuv.*

SYNGNATHIDÆ.

18. Corythoichthys fasciatus (*Gray*).

One specimen, differing from the description given by Kaup ('Lophobranchii,' p. 25) in having the median crest on the snout undenticulated, and in having the dorsal fin on 6 rings instead of 5.

19. Micrognathus brevirostris (*Rüpp.*).

20. Halicampus macrorhynchus, n. sp. (Plate **46**. fig. 4.)

Male unknown and position of brood-pouch therefore uncertain, but agreeing in all other respects with Duncker's diagnosis of the genus *Halicampus* (Jahrb. Hamburg. Wissensch. Anst. xxix. 1912, p. 236).

Similar in form to *Halicampus koilomatodon*, Bleek., differing notably as follows :—

(1) Snout much longer, $1\frac{3}{5}$ rest of head.
(2) Rings fewer, 14+27.
(3) Dorsal fin with 18 rays on 1+3 rings.
(4) Keels of scutes mostly entire or incompletely divided into two; not definitely serrated.

A single specimen, ♀, 112 mm. in length, from Suez.

21. Doryrhamphus excisus, *Kaup*.

22. Hippocampus guttulatus, *Cuv.*

23. Hippocampus histrix, *Kaup*.

HOLOCENTRIDÆ.

24. Holocentrus ruber (*Forsk.*).

SERRANIDÆ.

25. Epinephelus hemistictus (*Rüpp.*).

26. Epinephelus tauvina (*Forsk.*).

27. Pseudochromis olivaceus, *Rüpp.*

CHILODIPTERIDÆ.

28. Apogon annularis, *Rüpp.*

29. Apogon auritus (*Cuv. & Val.*).

30. Apogon variegatus (*Val.*).

CARANGIDÆ.

31. Caranx armatus (*Forsk.*).

32. Caranx bleekeri, *Klunz.*

LUTIANIDÆ.

33. Lutianus gibbus (*Forsk.*).

34. Lutianus bohar (*Forsk.*).

A single specimen, with the two white spots at base of dorsal very distinct. Günther (Cat. Fishes, vol. i. p. 191) says these spots disappear after death.

35. Lutianus quinquelinearis (*Bloch*).

36. Cæsio lunaris, *Cuv. & Val.*

POMADASIDÆ.

37. Plectorhynchus gaterina (*Forsk.*).

MULLIDÆ.

38. Upeneus barberinus (*Lacep.*).

LETHRINIDÆ.

39. Lethrinus mahsena (*Forsk.*).

40. Pagrus spinifer (*Forsk.*).

SPARIDÆ.

41. Chrysophrys bifasciata (*Forsk.*).

CHÆTODONTIDÆ.

42. Chætodon auriga, *Forsk.*

Seven specimens, forming a complete series from *C. setifer*, Bloch, with a distinct black spot on soft dorsal, to *C. auriga*, Forskål, with no trace of a spot. The intensity of the spot is not correlated with the size of the fish.

43. Chætodon fasciatus, *Forsk.*

44. Chætodon mesoleucus, *Forsk.*

45. Heniochus acuminatus (*Linn.*).

46. Holacanthus asfur (*Forsk.*).

POMACENTRIDÆ.

47. Dascyllus aruanus (*Linn.*).

48. Dascyllus marginatus (*Rüpp.*).

49. Pomacentrus cyanostigma (*Rüpp.*).

50. Pomacentrus tripunctatus, *Cuv. & Val.*

LABRIDÆ.

51. Julis lunaris (*Linn.*).

52. Cheilinus trilobatus, *Lacep.*

53. Cheilinus rhodochrous, *Günth.*

Three specimens, which differ from those in the British Museum in having a double dark band passing from the middle of the posterior margin of the eye to the base of the caudal and ending in a black spot on the caudal peduncle. A dark spot also present on the lateral line above the pectorals.

SCARIDÆ.

54. Pseudoscarus harid, *Forsk.*

55. Pseudoscarus niger, *Rüpp.*

MUGILIDÆ.

56. Mugil cunnesius, *Cuv. & Val.*

57. Mugil smithii, *Günther.*

A single specimen, agreeing fairly well with examples in the British Museum from Socotra and Natal. The species was originally described from the Cape.

ATHERINIDÆ.

58. Atherina pinguis, *Lacep.*

SIGANIDÆ.

59. Siganus stellatus, *Forsk.*

A single specimen, with 14 dorsal and 8 anal spines, one in excess of the number usually found in the genus.

60. Siganus nebulosa (*Q. & G.*).

61. Siganus rivulatus, *Forsk.*

TEUTHIDIDÆ.

62. Teuthis matoides (*Cuv. & Val.*).

63. Teuthis guentheri, *Jenk.*

(Bull. U.S. Fish. Comm. xxii. 1902, p. 477, fig. 29.)

A single specimen, agreeing exactly with *T. matoides,* except for the marking on dorsal fin—probably the same species.

64. Zebrasoma rüppellii (*Benn.*).

Two specimens, one in spirit and one dried skin, differing from Rüppell's and Günther's descriptions in having 4 spines in the dorsal fin. Rüppell's specimen in the British Museum has 4 spines, but the first is very small and was probably overlooked.

GOBIIDÆ.

65. Gobius echinocephalus, *Rüpp.*

Thirteen small specimens, differing from Rüppell's and Günther's descriptions in having a pair of small but well-defined canines in the lower jaw. Canines are present in Rüppell's specimens in the British Museum.

66. Gobiodon reticulatus, *Günth. & Playf.*

67. Gobiodon citrinus (*Rüpp.*).

68. Gobiodon ceramensis (*Bleek.*).

69. Asterropteryx semipunctatus, *Rüpp.*

BLENNIIDÆ.

70. Petroscirtes ancylodon, *Rüpp.* (Plate **46**. fig. 2.)

(N. Wirb., Fische, p. 1, Taf. i. fig. 1.)

As our specimen differs in some particulars from Rüppell's description, it will be well to give the characters in full.

Height of body 4, length of head $3\frac{2}{3}$ in total length (without caudal). Diameter of eye $4\frac{1}{5}$ in head, almost equal to interorbital width. Snout moderate; cleft of mouth extending a short distance behind anterior margin of eye. Canine teeth very large in lower jaw, small in upper. A pair of small barbels present on chin and simple paired tentacles on supraorbital margin, occiput, and above gill-openings. Dorsal 30, undivided, highest anteriorly; last ray attached by a membrane to caudal peduncle anterior to base of caudal rays. Anal 19. Caudal rounded. Pectoral shorter than head, not extending to origin of anal.

Colour in spirit light brown; back with six irregular dark brown cross-bars extending on to dorsal and anal fins. Caudal with opaque white margin.

A single specimen from Suez, 8·5 cm. in length, differing from Rüppell's description and figure in the presence of tentacles on occiput and above gill-openings, barbels on chin, and opaque white margin to caudal.

71. Petroscirtes mitratus, *Rüpp.*

72. Petroscirtes mekranensis, *Regan.*

("Fishes of Persian Gulf," Journ. Bomb. Nat. Hist. Soc. xvi. 1905.)

A single specimen from Suez, differing from the type in the shape of the crest, which is bilobed, probably due to injury during life.

73. SALARIAS FRONTALIS (*Ehrenb.*), *Cuv. & Val.* (Plate **46**. fig. 1.)

(Hist. Nat. des Poiss. xi. p. 328, 1836.)

Depth of body nearly equal to length of head, which is about $4\frac{1}{2}$ in total length (without caudal). Diameter of eye $3\frac{2}{3}$ in head and $1\frac{1}{2}$ times the interorbital width. Forehead projecting beyond the snout; cleft of mouth extending to below posterior margin of eye. Canine teeth present. Anterior nostrils with a pair of well-developed simple tentacles, which arise at a short distance from the orbital margin in front of the middle of the eye. No supraorbital or occipital tentacles. No occipital crest. Dorsal 12/19, highest posteriorly, the longest rays equal to height of body below them; margin straight, without notch; last ray attached by a membrane to the caudal peduncle anterior to the procurrent caudal rays. Anal 22. Caudal rounded, but with one ray on both dorsal and ventral borders produced. Pectoral shorter than head, not extending to origin of anal.

A single specimen, 6·5 cm. in length, from Suakim.

This species agrees in most characters with *Salarias melanosoma*, Regan *, from Christmas Island, and *Salarias anomalus*, Regan †, from the Persian Gulf, but both of these have the dorsal fin notched.

Günther ‡ includes *Salarias frontalis* in the synonymy of *Salarias fuscus* with a query, but it is quite distinct from that species.

74. SALARIAS QUADRIPINNIS, *Rüpp.*

CONGROGADIDÆ.

75. HALIOPHIS GUTTATUS, *Rüpp.*

SCORPÆNIDÆ.

76. SEBASTES POLYLEPIS, *Bleek.*

77. SCORPÆNA LONGICORNIS, *Günth. & Playf.*

(Fishes of Zanzibar, p. 47, pl. 8. fig. 1, 1866.)

78. PTEROIS MILES (*Benn.*).

79. SYNANCEIA VERRUCOSA, *Schneid.*

PLATYCEPHALIDÆ.

80. PLATYCEPHALUS INDICUS (*Linn.*).

* Proc. Zool. Soc. 1909, p. 406, pl. 66. fig. 5.
† Journ. Bombay Nat. Hist. Soc. vol. xvi. 1905, p. 327, pl. 2. fig. 4.
‡ Cat. Fish. vol. iii. p. 245.

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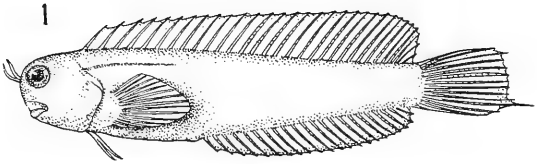

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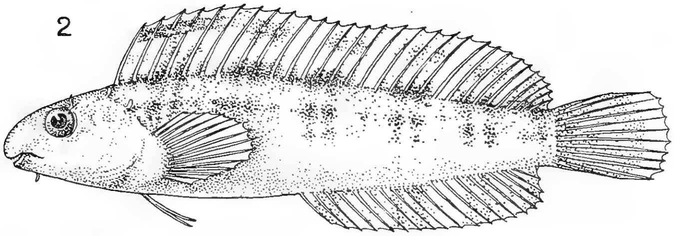

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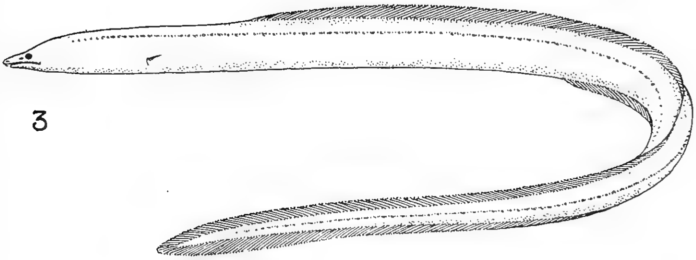

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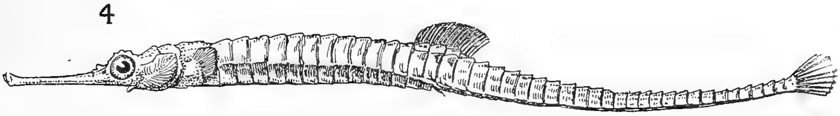

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SUDAN FISHES.

ECHENEIDIDÆ.

81. Echeneis remora, *Linn.*

82. Echeneis naucrates, *Linn.*

A single specimen from Suez, with irregular dark blotches on the sides instead of the more usual longitudinal band.

BOTHIDÆ.

83. Platophrys pantherinus (*Rüpp.*).

84. Scæops pœcilura (*Bleek.*).

BALISTIDÆ.

85. Balistes fuscus, *Schneid.*

86. Balistes flavimarginatus, *Rüpp.*

87. Balistes assasi, *Forsk.*

MONACANTHIDÆ.

88. Monacanthus setifer, *Benn.*

TETRODONTIDÆ.

89. Tetrodon immaculatus, *Schneid.*

90. Tetrodon stellatus, *Schneid.*

91. Tetrodon hispidus, *Linn.*

A single specimen, with blackish longitudinal lines on the abdomen and with five black subvertical blotches on each side of abdomen, thus combining the complete markings of both Günther's varieties (Cat. Fish. vol. viii. p. 297).

EXPLANATION OF PLATE 46.

Fig. 1. *Salarias frontalis*, Cuv. & Val. Nat. size.
2. *Petroscirtes ancylodon*, Rüppell. Nat. size.
3. *Neenchelys microtretus*, n. sp. Nat. size.
4. *Halicampus macrorhynchus*, n. sp. Nat. size.

INDEX.

[Synonyms and native names are printed in *italics*. A star * denotes the first publication of a name.]

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